

Collaborative Orienteering Mapmaking with Open software

Version: 1.1 (1st English version, 10.08.2012)

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Introduction

Purpose of this document is describing the method of on-line cooperative orienteering map making for its potential users. Each step of this description can be performed with free software. This description is based on the following COMO tutorials from Sweden:

<http://wiki.openstreetmap.org/wiki/IOFmapping>

<http://como.oextract.se/>

Thanks to David Svantesson, who invented the theoretical and technical basis of this method and to Dr. László Zentai for the revision of this document.

Creating contours

Creating contours is a relatively complicated process, but it is not necessary to perform it by every user. It is enough if coordinator of a certain map area performs this action then share the osm file containing the contours.

1. 1st method: Generating rough contours from NASA SRTM data base

This method is rather comfortable, however the 30m resolution of SRTM data base results in a rough contour pattern when the standard 5 m contour distance of IOF maps is used. Method is the following:

- Install the **Strm2osm** software (download site: <http://osm.michis-pla.net/code/Srtm2Osm-1.9.7.0.zip>)
- Run software from command prompt with the following command:
`srtm2osm -bounds1 47.5339 18.9651 47.5521 18.9925 -step 5 -cat 1000 25`
(First coordinate is the S-W corner; second coordinate is the N-E corner of the map area. Coordinate format is dd.ddddd.)
- Open the generated osm file in **Merkaartor** editor
- Select all the contours then add the following OSM tags to them: *iof:contour*; *type:normal* (in left bottom corner of SW window).
- Select the index contours (every 5th) and modify their tags to *type:index*.
- Export the contours to a new osm file from **Merkaartor** editor: *File > Export*.
- **Do not upload any contour onto an OSM server; handle them separately during the whole map making process!**

Further description: <http://wiki.openstreetmap.org/wiki/Srtm2Osm>

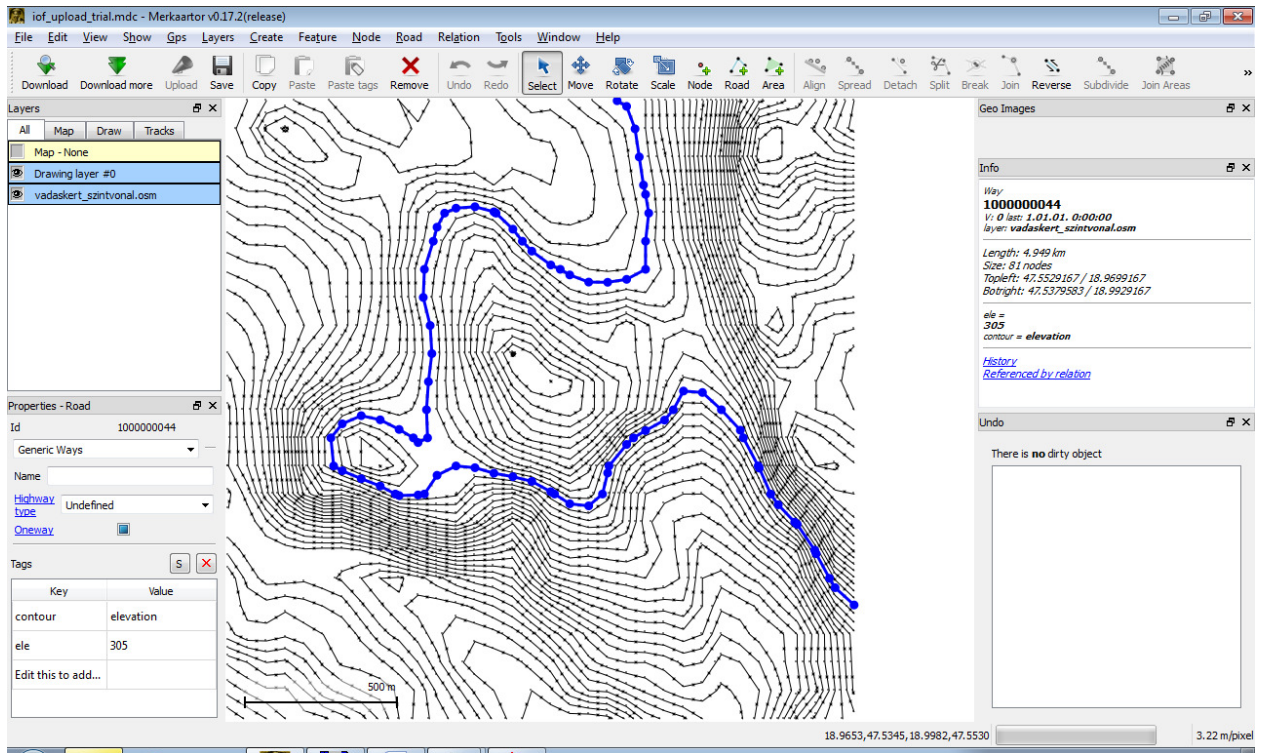


Fig. 1: Contours generated by Strm2osm

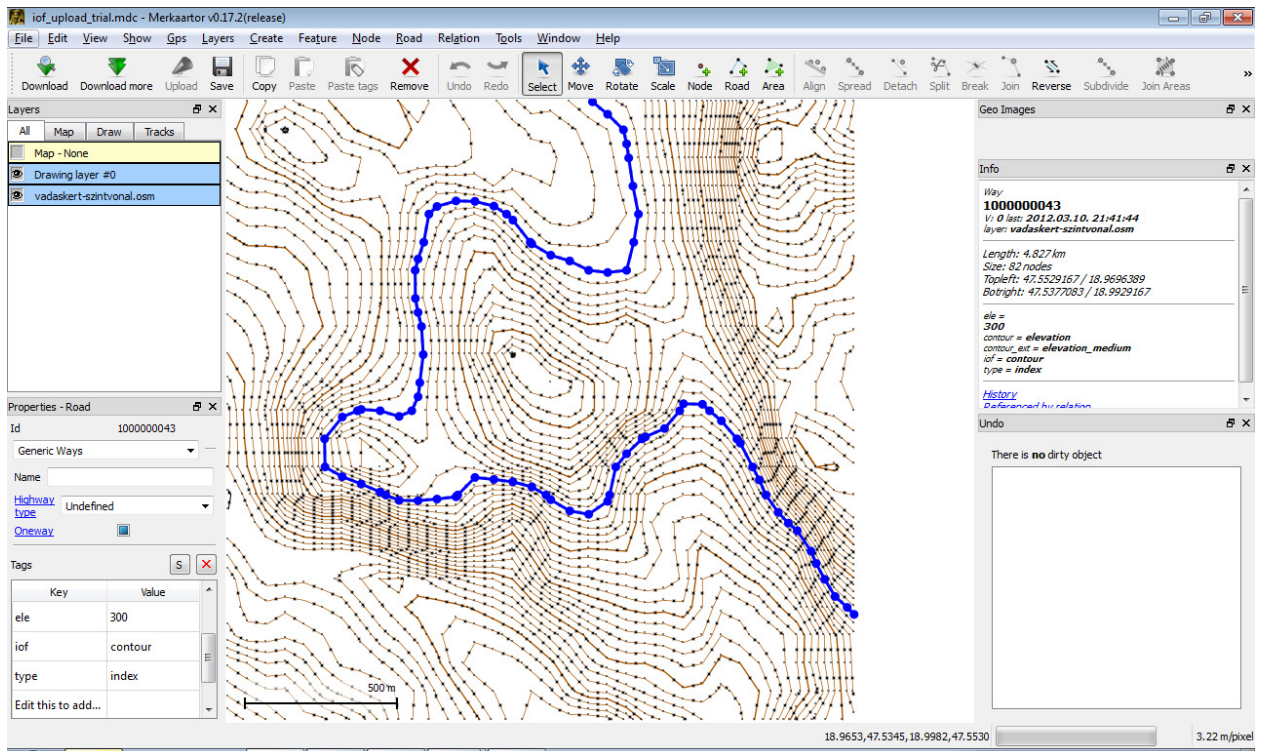


Fig. 2: Brown contours after adding IOF tags

2. 2nd method: Copying contours from existing maps

The **Walking paper** feature of **Merkaartor** editor provides an image layer that can be used for copying objects from existing maps. Using Walking papers is described in a separate chapter. The copied contours also have to be tagged as *iof:contour; type:normal* or *iof:contour; type:index* (for index contours), then they have to be exported into a separate osm file.

This contour file has to be handled separately during the whole map making process, uploading contours to OSM server is forbidden!

Editing map

There are several choices for editing Open Street Map (JOSM, web editor, etc.), but **Merkaartor** editor fits best for special requirements of IOF mapping. This is the most similar to OCAD editor; therefore present document describes only this editor. General user manual for **Merkaartor** editor can be found at <http://merkaartor.be/wiki/merkaartor/Documentation>, this document describes only the most important methods of IOF mapping.

Special settings of Merkaartor SW for IOF mapping

Merkaartor software has no built in support for IOF symbols; therefore ISOM style has to be installed separately by the following way:

- Download and unpack zip file of ISOM style into **Merkaartor** directory.
- Register ISOM style in the software: *Tools > Preferences > Style* tab, and then giving the path of ISOM.mas file.
- Apply the ISOM style in Merkaartor: *Tools > Styles > ISOM.mas*

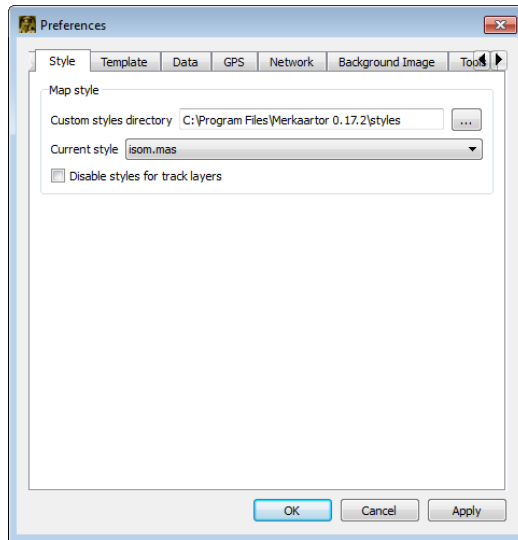


Fig. 3: Setting ISOM style in Preferences Menu

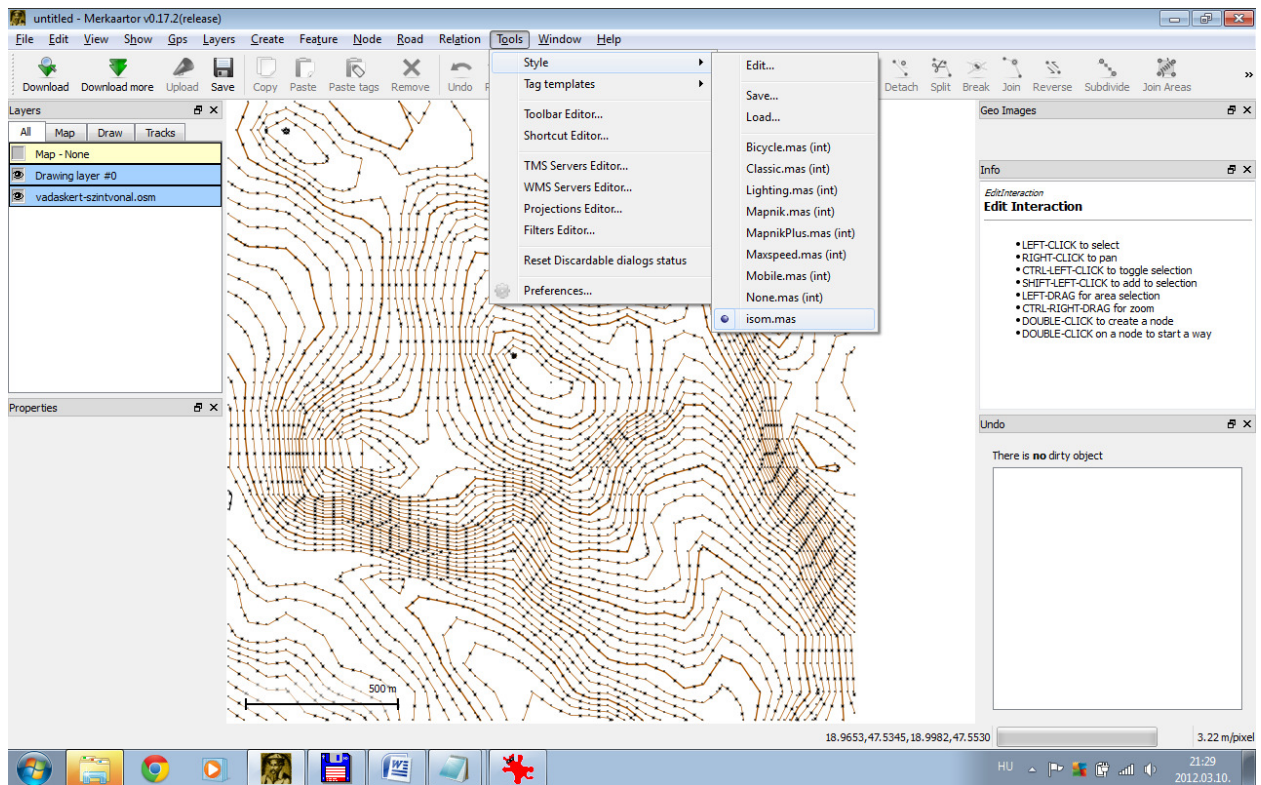


Fig. 4: Selecting ISOM Style

Basic operations, creating map objects (features)

If there is no **Merkaartor** project for a given map area yet then first open the osm file containing the contours. Contours appear with small red dots background pattern. This pattern indicates that

existing OSM map features are not yet downloaded from OSM server for the given area. This background pattern can be eliminated by downloading the available OSM data, or by unselecting the *Show > Show downloaded areas* option.

Clicking onto the **Download** button Merkaartor SW downloads the available map objects (features) from OSM server and the red dotted background pattern disappears.

Some basic method for navigating in map window:

- **Zoom in/out:** mouse wheel
- **Move the map:** move the mouse with right click

Adding IOF tags to existing OSM features

If there are existing OSM features that should appear on IOF map, but has no IOF tag yet, then the appropriate IOF tags have to be added to them (in the left bottom corner of SW window). Tags can be chosen from the table of [Annex A: Tagging rules of ISOM symbols](#). It is recommended to print this table and keep it in hand while map editing in order to accelerate finding the right IOF tags. If ISOM style is selected in **Merkaartor** and tags are given correctly then features appear as ISOM symbols. It is recommended to check the existing tags of a feature before adding the IOF tag. If there is a *layer* tag, then it can make complications during the map generation, as it modifies the drawing order of map objects. In this case it may be better to make a copy of feature and add IOF tags to the copy.

Adding new features

New features can be added by clicking onto **Node**, **Road** or **Area** buttons.

- **Node** button: Creating a simple feature (e.g. pit, tree); every new click onto map area adds a new feature.
- **Road** button: Creates linear feature (e.g. path, road, boundary); every click onto map adds a new point of the linear feature. End point of the feature can be made by double click.
- **Area** button: Creates area feature (e.g. forest area, settlement area); every click onto map adds a new point of area boundary. Close the boundary line for finish the process.

After creating the features their IOF tags have to be added in left bottom corner of **Merkaartor** window. Several features can be tagged together by using multiple selections. Tagged features appear with their ISOM symbols (or at least with their quasi ISOM symbols). New or modified features are marked by a red dot or red line, which indicates that they are not yet uploaded onto OSM server (**Dirty Features**). It is recommended to decrease the width of red line by the following settings: *Tools > Preferences > Colors* tab, and then change *Dirty* to 1 pixel.

If 1 pixel red marking is still disturbing (e.g. in case of making a print from **Merkaartor**) then it can be eliminated by the following way: Unselecting the *Show > Highlight dirty features* checkbox.

After adding the necessary features, map should be saved into *.mdc* file as a Merkaartor project. If the new or modified features are correct and they have no problems concerning intellectual property right (own survey or written permission of used map source owner; see <http://www.openstreetmap.org/copyright> for more details) then they can be uploaded to OSM server by **Upload** button. Uploading requires a registration, which can be made at <http://www.openstreetmap.org/>. If new features have IOF tags only then they will not appear on normal web interface of OSM. However they will appear in OSM web editor as thin black lines or dots and their tags can also be seen. They appear as IOF map only by using the Merkaartor editor if ISOM Style is selected.

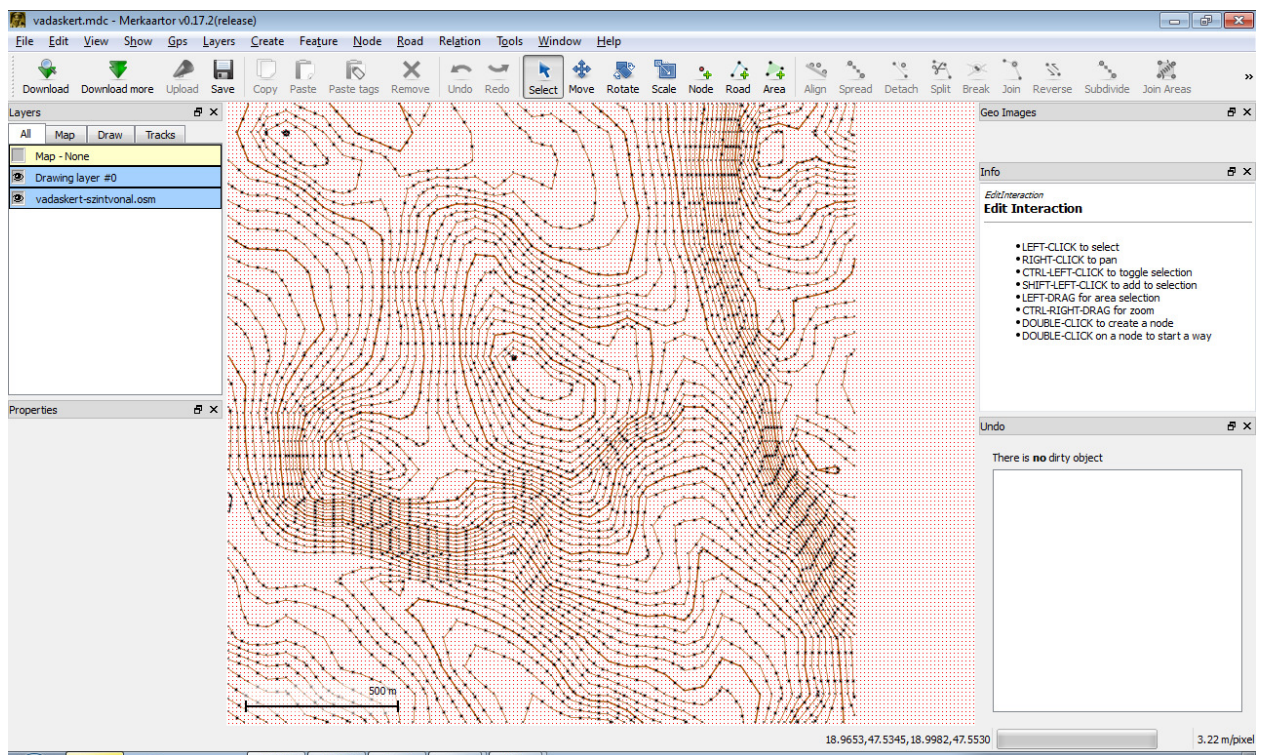


Fig. 5: Dotted background before downloading the existing features

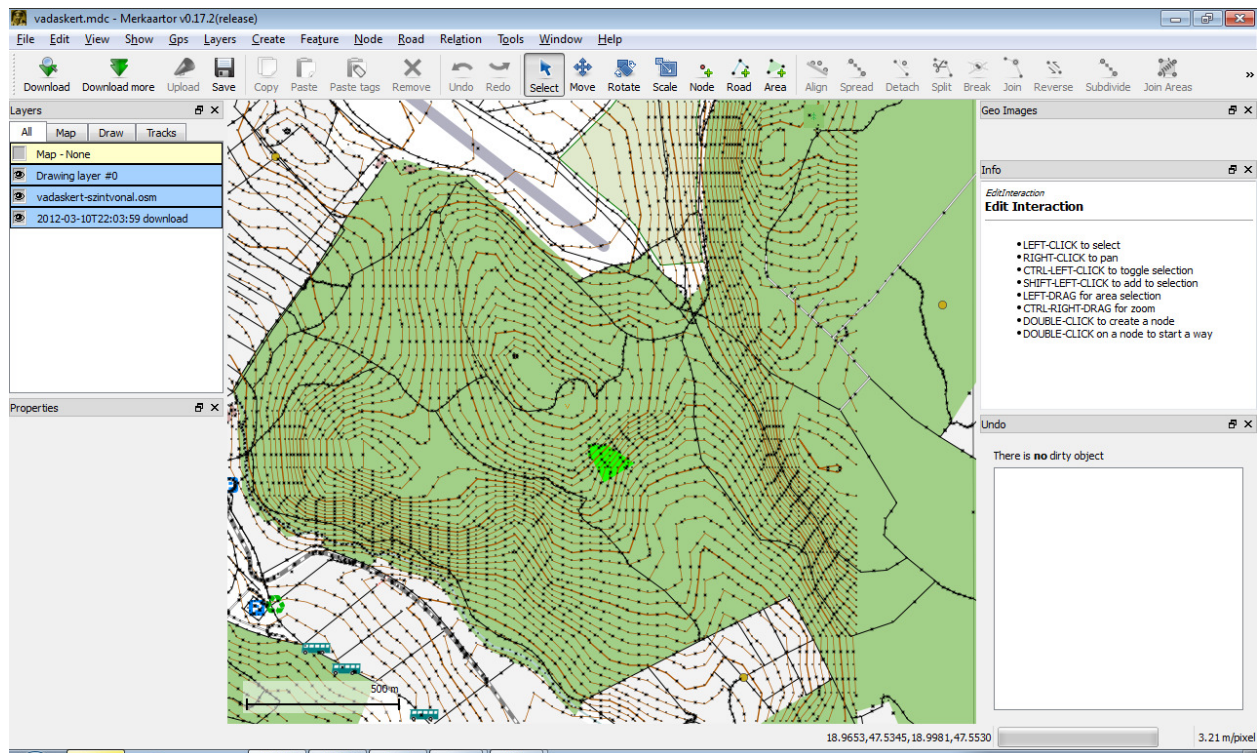


Fig. 6: Map view after downloading OSM data

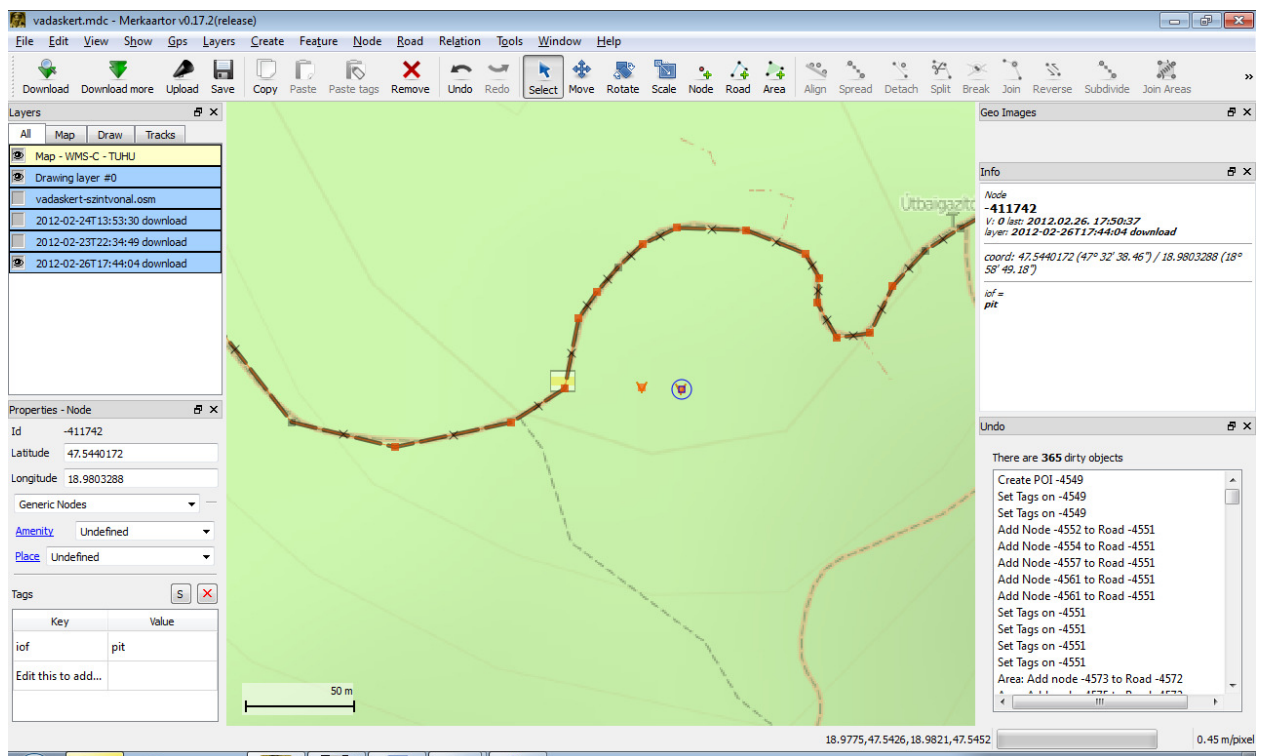


Fig. 7: Creating and tagging a Node Feature

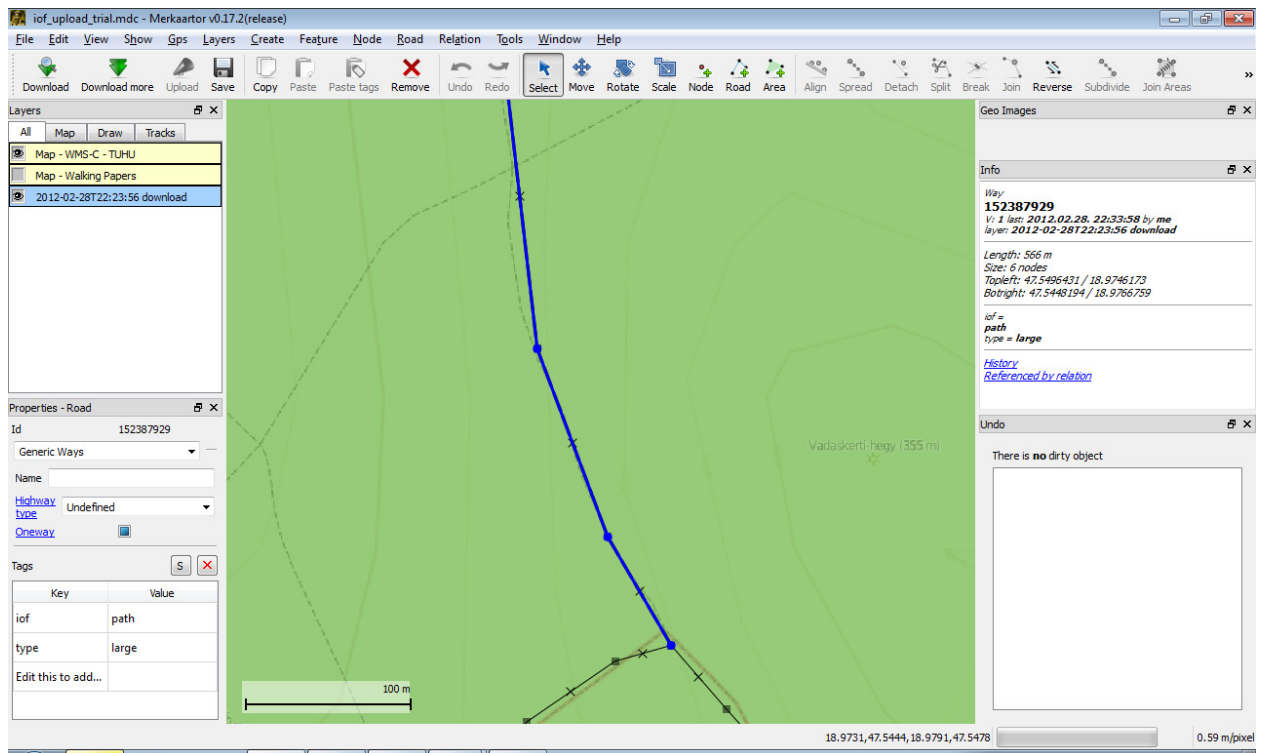


Fig. 8: Creating and tagging a Road Feature

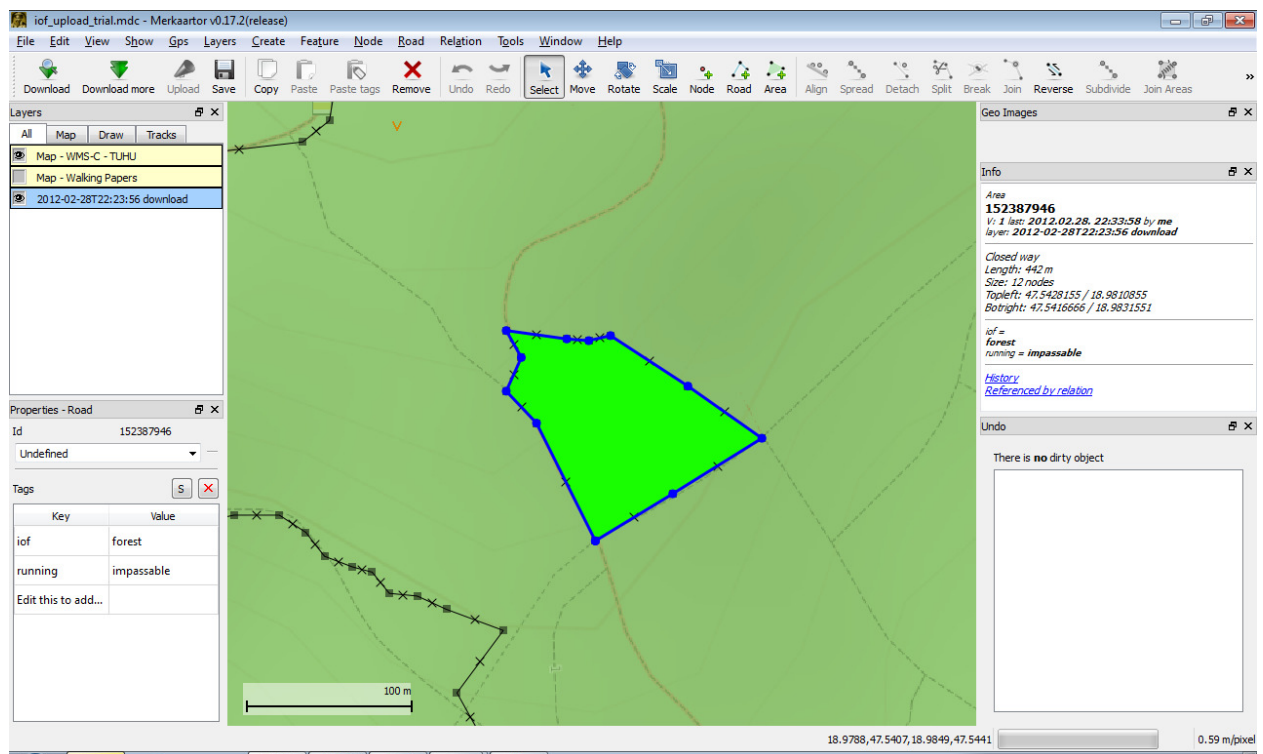


Fig. 9: Creating and tagging an Area Feature

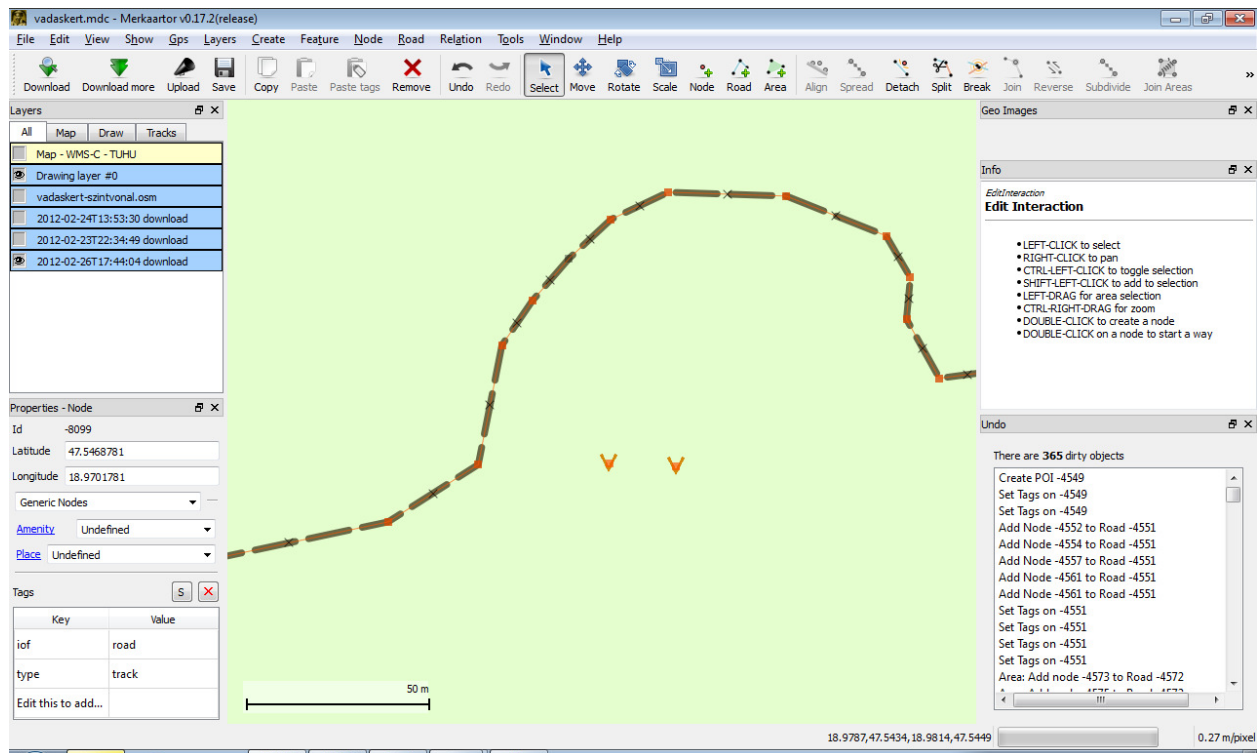


Fig. 10: Indicating Dirty features by red line or dot

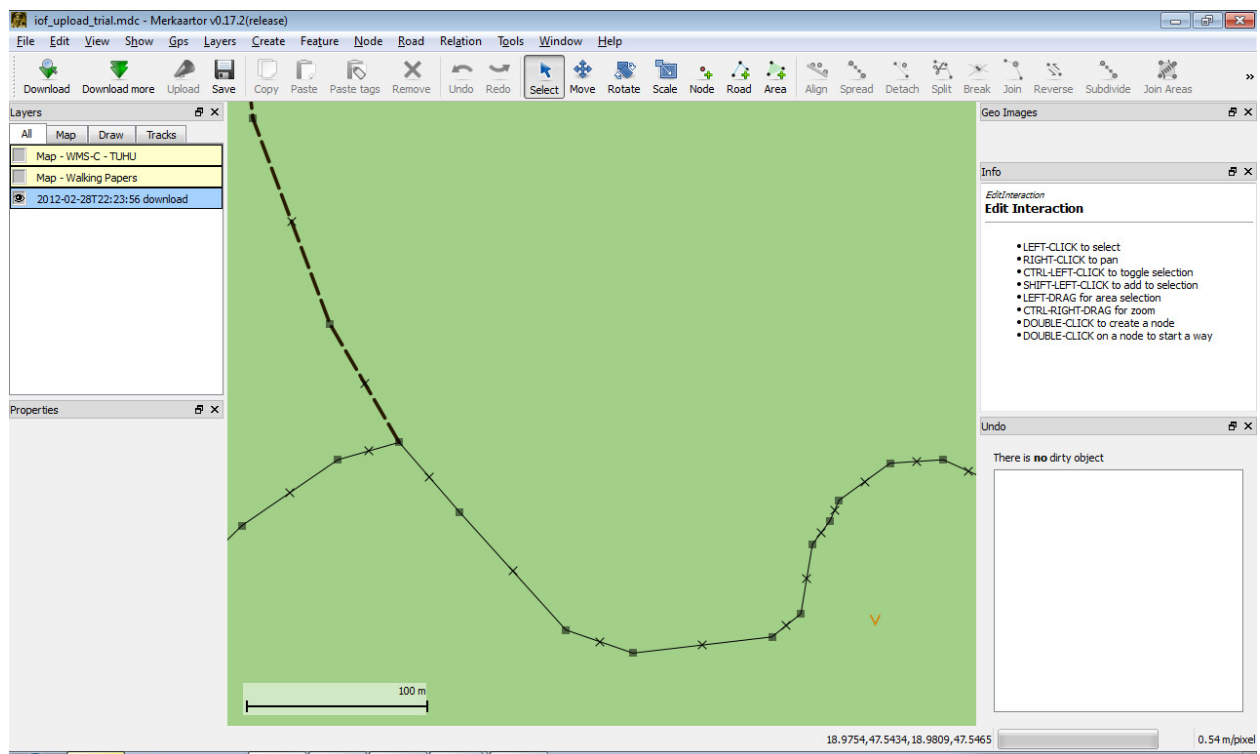


Fig. 11: Red lines/dots disappear after uploading onto OSM server

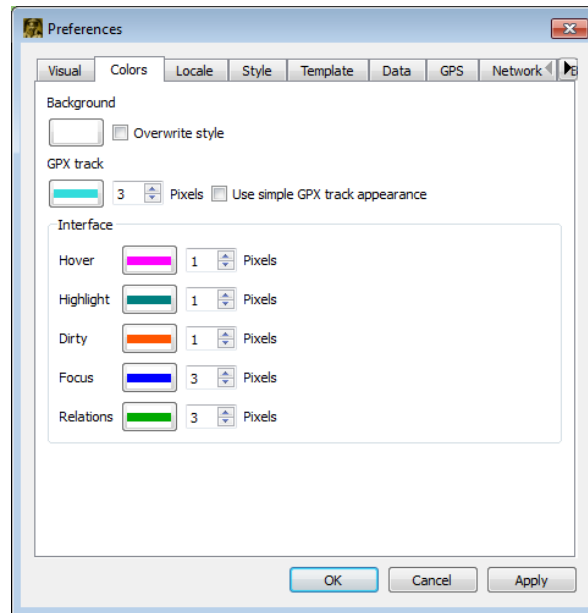


Fig. 12: Setting line width of Dirty Features marking

Important rules for editing (differences in appearance between Merkaartor and Osmarenderer)

Unfortunately map appearance in **Merkaartor** is not exactly the same as the final map generated by **Osmarenderer**. This behavior is called *almost WYSWYG* (What You See is What You Get).

Rules described in this chapter have to be respected in order to have a correct final map after map generation by Osmarenderer.

Asymmetrical road features

Due to the limitation of **Merkaartor** style editor it is not possible to define asymmetrical (comb shaped) symbols (e.g. cliff, fence, tunnel entrance, etc.), therefore approximate quasi symbols are used during map editing. **Osmarenderer always draws the pins of asymmetrical or comp shaped features onto the right side of their drawing direction.** Drawing direction of a feature can be checked in **Merkaartor** editor by selecting it, then select the *One-way* option in its *Properties* window. There is a separate button in the menu bar for reversing the direction of a feature.

Overlap of Area features

Merkaartor indicates the area features according to their creation order, while **Osmarenderer** applies the rendering order of each ISOM symbols, which is defined in *isomrules.xml* file. This difference can

result that an area feature visible in **Merkaartor** editor will not be visible on the final map generated by **Osmarenderer**.

Following rules define the possible cases when an area feature can be created over another one. In other cases a hole has to be cut in the existing area feature before adding the new one over it. Else the new area feature will not appear on the final map.

General rendering order of *isomrules.xml* (last item will be on the top):

- open_land
- forest
 - running:easy
 - running:slow
 - running:difficult
 - running:impassable
- open_land_in_forest
- settlement
- water
- road area
- building

During definition of above rendering order it was aimed to minimize the need for hole cutting in the map editing process. The *open_land_in_forest* tags (as copy of *open_land* tags) were created definitively for this reason.

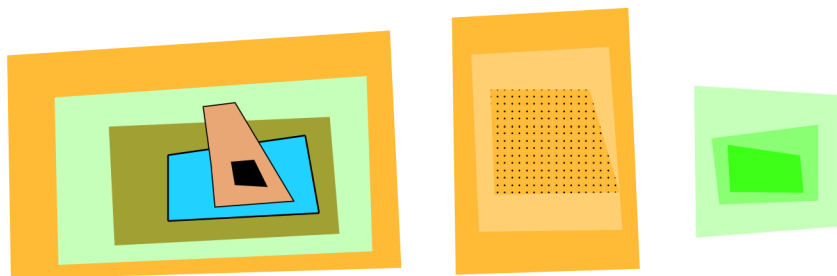


Fig. 13: Examples for allowed area feature overlaps without hole cutting

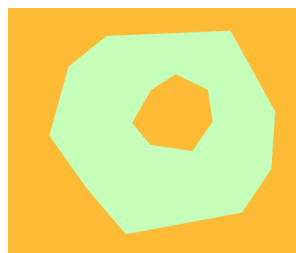


Fig. 14: Allowed combination of overlapping area features without hole cutting (inner open land tagged as *open_land_in_forest*)

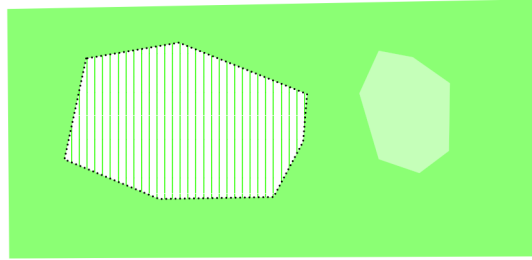


Fig. 15: Area feature combinations requiring hole cutting

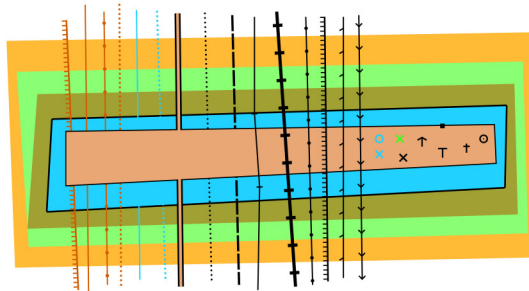


Fig. 16: Demonstration of rendering order of different road and area features

Cutting holes into area features

If the desired area feature combination cannot be implemented by the overlap rules of previous subchapter (e.g. a clear forest area within a dense forest area) then a hole has to be cut into the outer area feature. It is a relatively complicated process, but it can be done quickly after having practice, and it is has to be done relatively rarely.

Important remark: The in-fill color/pattern of the new hole will remain the color/pattern of outer area in **Merkaartor** editor, but it will be rendered properly by **Osmarenderer**.

Cutting hole into a new area feature

- Click on **Area** button, and then draw the outline of the area.
- There will be a pop-up window at the closing of the outline (*Do you want to add a(nother) hole to this area?*). Choose *Yes*, and then draw the outline of the hole.
- **Tags of complex area features (areas having holes) has to be assigned to the area feature itself by selecting its outline. Do not add IOF tags to area relations, as they are not processed by Osmarenderer.**

Cutting hole into an existing area feature, which has no hole yet

- Select the outline of area feature then remember its ID (see *Properties* window)
- Draw the outline of the hole as an area feature then remember its ID

- Select both the outlines of original area feature and the hole (by pushing *Shift* button during selection), and then *Create > Relation*
- Add the necessary tags to the relation:
 - ID of original area feature outline: *role=outer*
 - ID of hole outline: *role=inner*

Cutting hole into an area feature, which already has hole(s)

- Draw outline of the hole,
- Add to selection the *Relation* containing the original area feature and its previous hole(s)
- Add outline of new hole to the relation: *Relation > Add Member*
- Add relation tag for new hole in the relation properties window: ID of new hole outline: *role=inner*

Proper tagging of hole infill

If IOF tags are added directly to outline of the hole, then they will not be processed by Osmarenderer. Therefore a copy of the hole outline has to be created first, then IOF tags has to be added to the copy of the hole outline. In this case hole infill will be rendered properly by Osmarenderer on the final map. Copying of hole outline is simple:

- Select the hole outline then click onto **Copy** and **Paste** buttons.
- For selecting the copy of hole outline click onto the outline. Double circles around the points of outline indicate that there are more features over each other.
- The newly created outline is listed as second one in the left bottom window of **Merkaartor**, so click to this list item for selecting the proper outline for IOF tagging (first list item corresponds to the start point of the new outline).
- It is also possible to use the Tab button of keyboard for selecting the right object in case of multiple selections.
- If copy of hole outline has been selected then IOF tags for hole infill can be added.

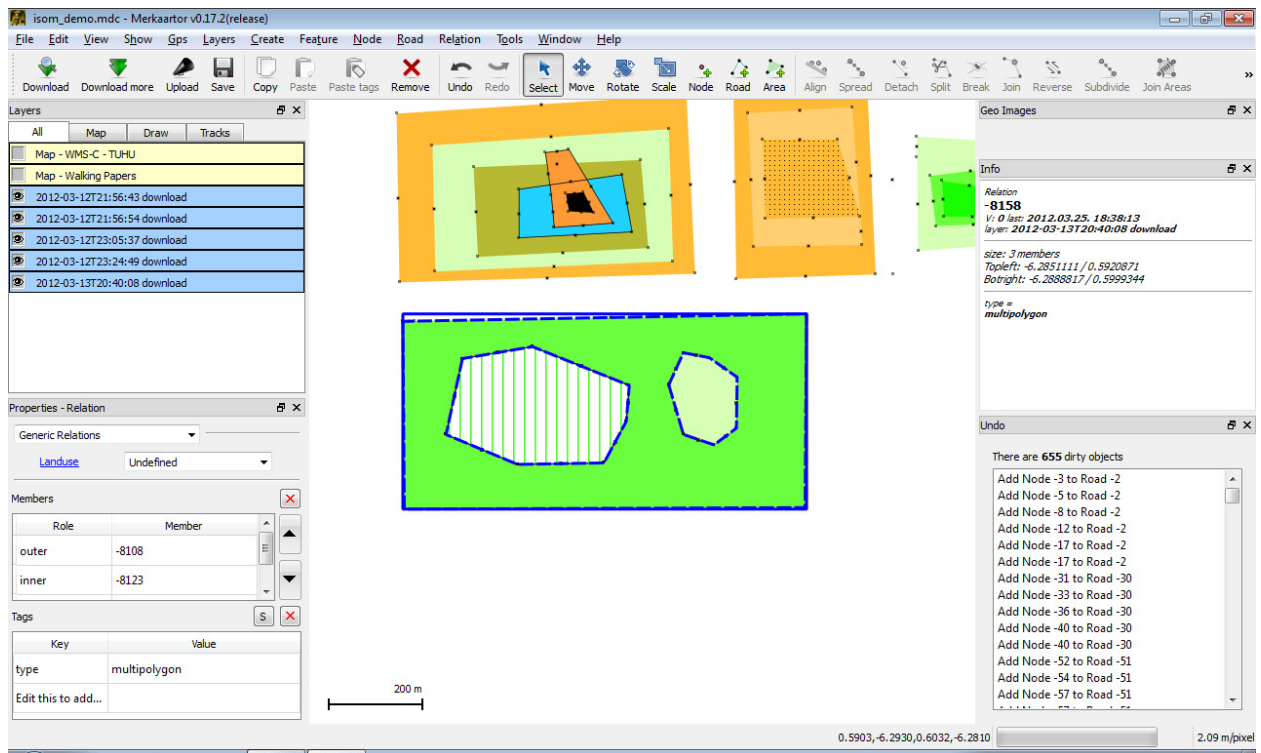


Fig. 17: Tagging for hole cutting by using *type=multipolygon Relation*

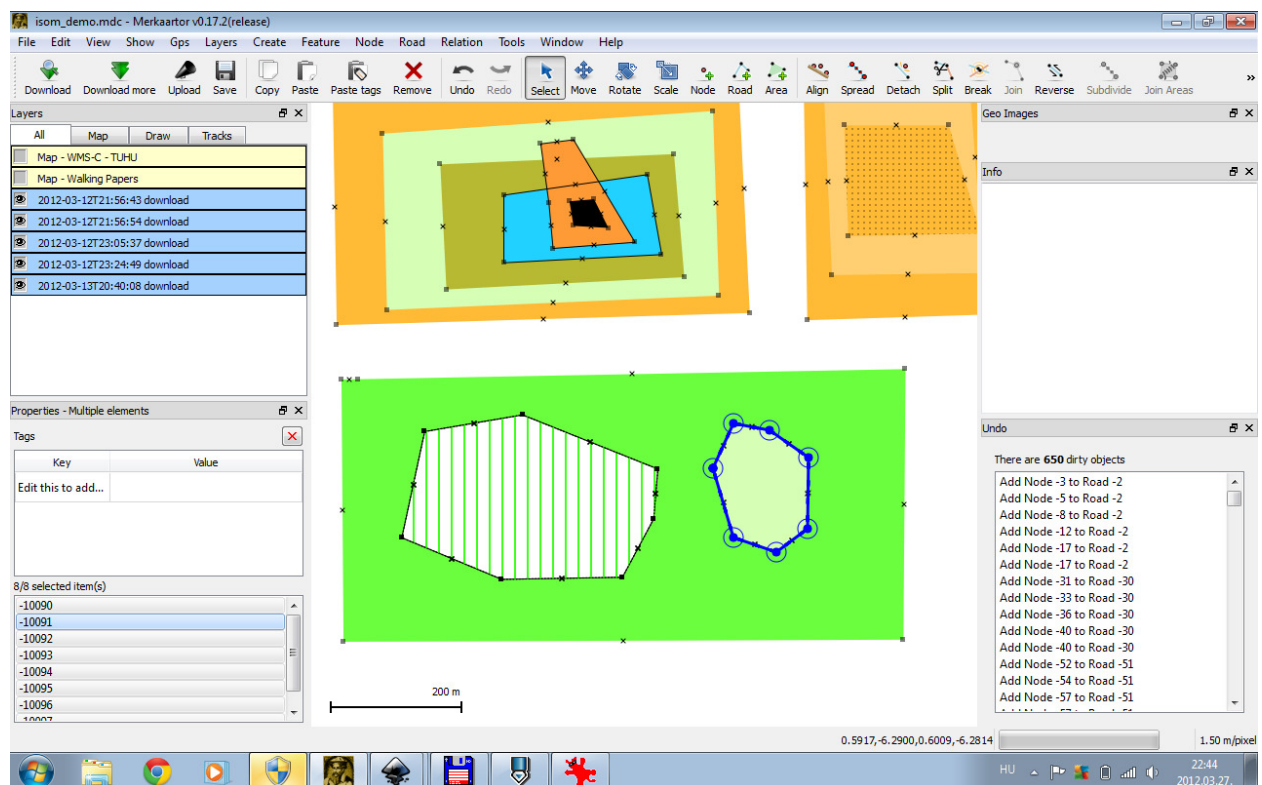


Fig. 18: Selecting the copy of hole outline for adding IOF tags of hole infill (2nd item in the left bottom list corresponds to new outline)

Infill of areas limited by road features

OSM editors enable creating *type=boundary Relation*. In this case area can be defined as a relation of limiting road features, and tags for area infill can be added to this relation. However **Osmarenderer** cannot handle IOF tags for relations, so this method shall be avoided in case of o-map creation.

It means that even there are road features limiting an area, outline of area has to be created again in order to add the IOF tags for area infill. It can be effective to make copy of limiting road objects, cut their sections limiting the area, then merge these sections into an area outline and add the IOF tags.

Methods for facilitating map creation

Loading GPS tracks

File > Import menu of **Merkaartor** enables loading own GPS tracks. Before tagging own GPS tracks it is recommended to check if these roads are already present in OSM database (**Download** button).

It is not possible to add tags directly to imported GPS tracks, therefore tracks has to be extracted into a drawing layer for editing: Right click on label of GPS track layer, then select *Extract Drawing layer*. Track in this new extract layer can be edited and tagged as a road feature. From this editing phase it is recommended to hide the original GPS track layer by clicking onto „eye” icon near the label of layer.

Useful **Merkaartor** functionalities for editing and tagging GPS tracks:

- **Split** button: Enables splitting GPS track into sections that can be selected and tagged separately (e.g. one section of the track is a road another one is a path). If **Split** button is applied when multiple points are selected, then track will be split into multiple sections in one step. For selecting split points, first select the road feature, and then click onto split points while pushing the *Shift* button of keyboard. Finally click onto **Split** button. This functionality can also be used for removing the redundant parts of GPS track.
- **Break** button: It doubles the selected point of a road object, so it will become two disconnected ending points, which can be moved independently from each other. This functionality is proposed for separating the branching roads at their junction.

Remark: It is not necessary to have an expensive GPS receiver for creating GPS tracks and way points. The free **Oruxmaps** software can be downloaded even to the simplest **Android** smart phone and enables recording tracks and way points then exporting them to *gpx* or *kml* format that can be imported by **Merkaartor**. However dedicated GPS receivers provide more accurate tracks.

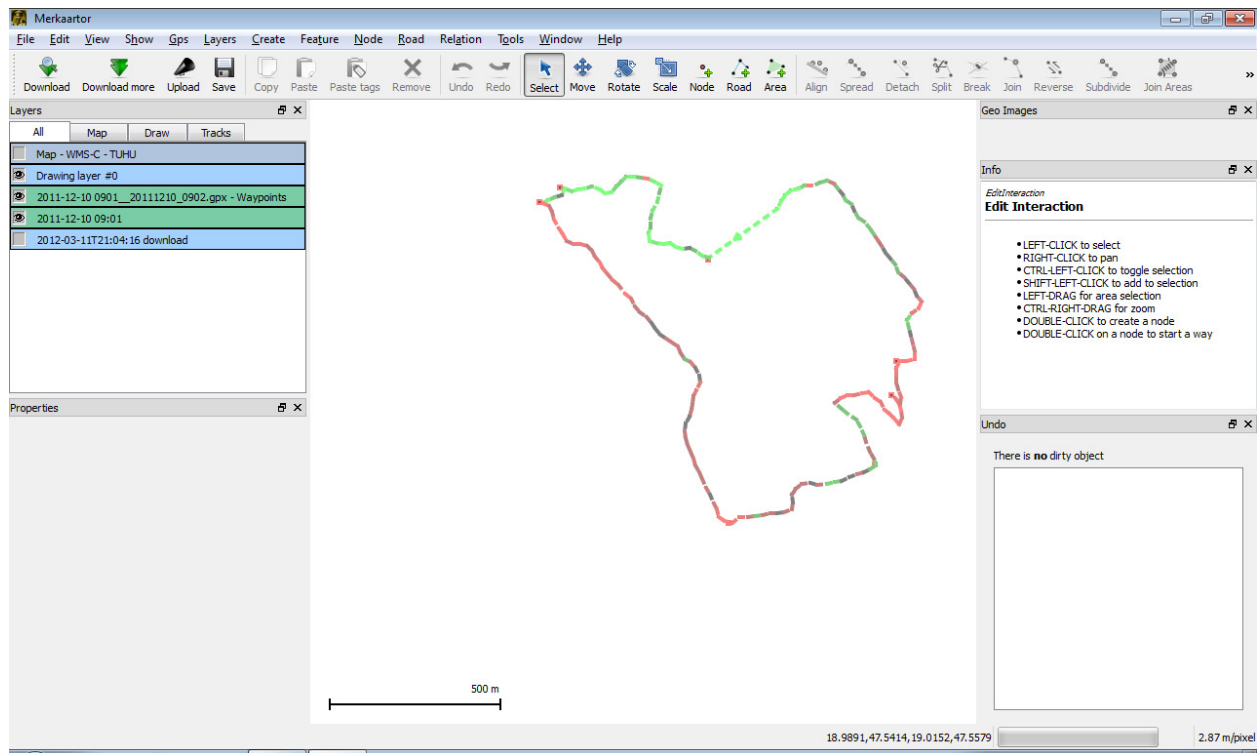


Fig. 19: View of imported GPS tracks and way points in Merkaartor

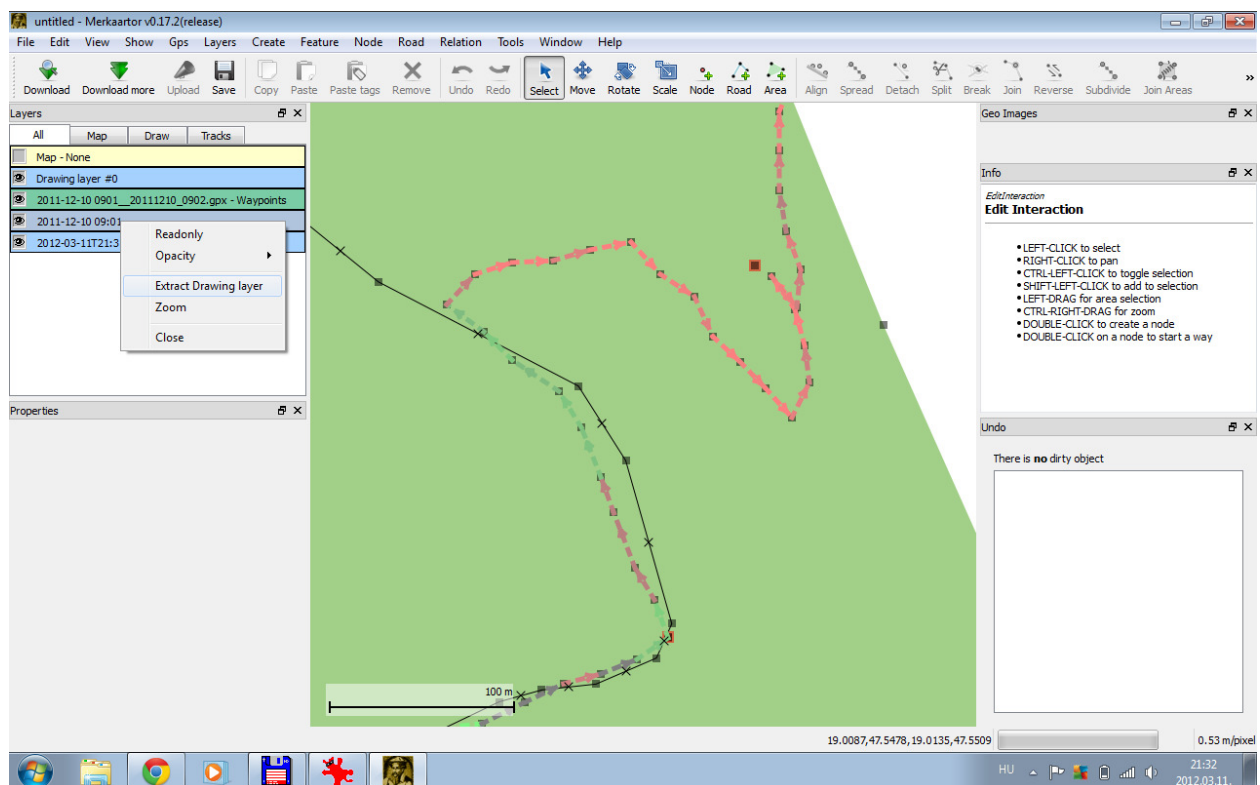


Fig. 20: Extracting GPS data into a drawing layer for editing and tagging

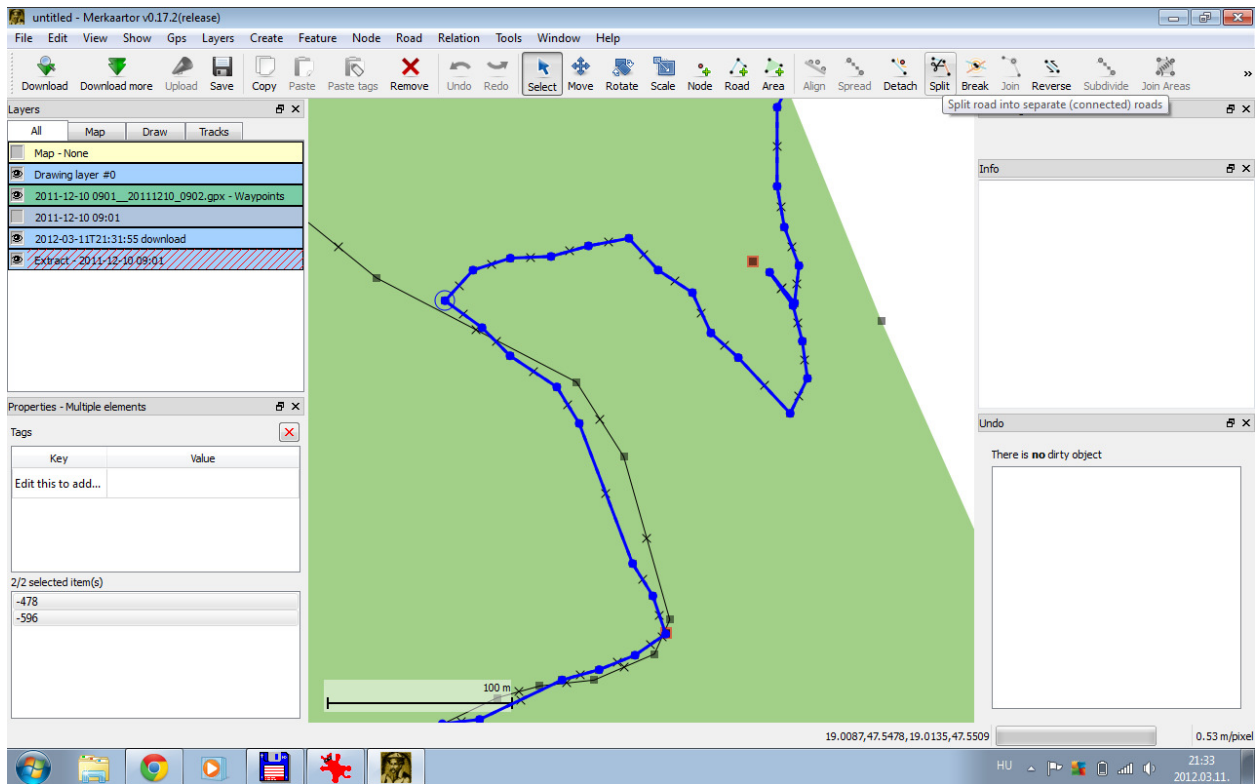


Fig. 21: Splitting GPS track into sections in Extract layer

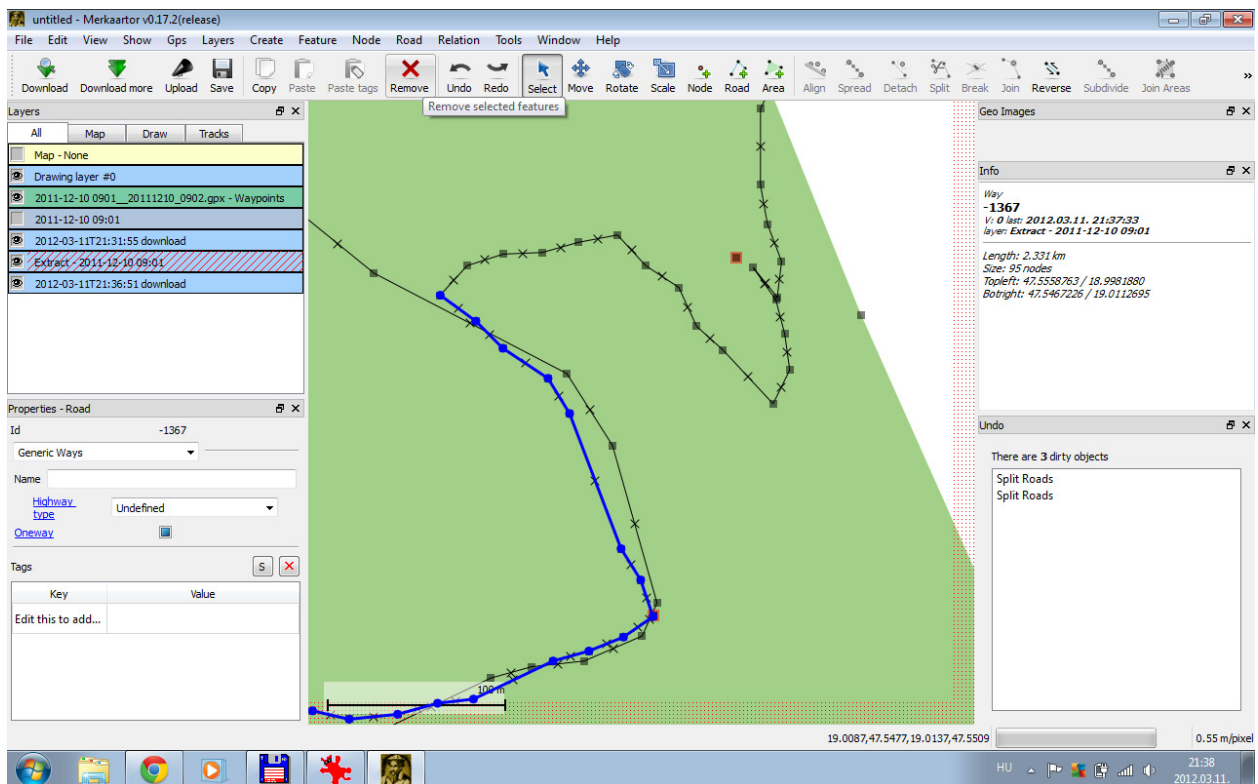


Fig. 22: Removing redundant parts of GPS track after splitting

Setting on-line map source as background

Merkaartor provides possibility for setting on-line maps as background. For example **turistautak.hu** (TUHU) is a good WMS service for Hungarian trekking maps having detailed forest trail network.

Due to IP right issues it is usually forbidden to copy tracks from on-line map sources, but they can be used for checking distortion of old orienteering maps or checking accuracy of own GPS tracks. OSM has general agreement for using BING aerial photo, so it is allowed to draw its objects onto OSM maps

Setting a WMS maps source as background of **Merkaartor** editor can be done by the following method (example for turistautak.hu WMS server):

Tools > WMS Servers Editor..., then give the address of WMS server (Server URL):

<http://terkep.turistautak.hu/tiles/turistautak-domborzattal/{Sz}/{Sx}/{Sy}.png>

Create a new image layer for the on-line map background:

Layers > Add new Image layer; right click on the label of new layer ("Map - None"), then select the following in the pop-up menu: *WMS Adapter > TUHU*

It is also useful to set **Bing aerial photo** as background by the following method: *Layers > Add new Image layer*; right click on the label of new layer ("Map - None"), then select the following in the pop-up menu: *Plugins > Bing Maps*

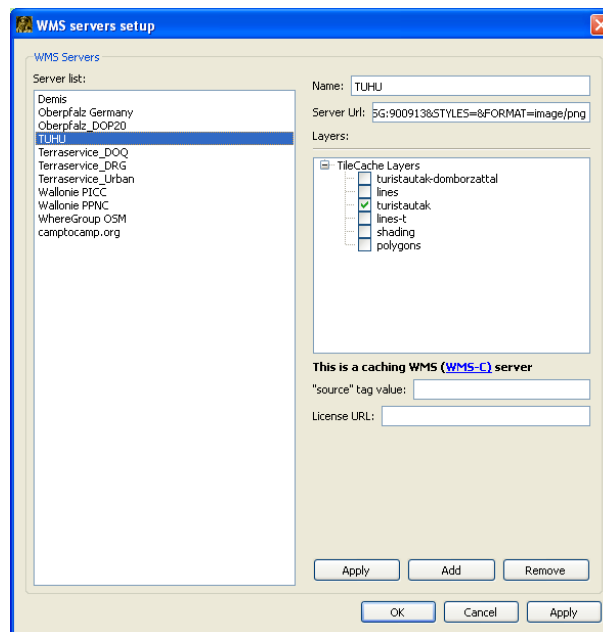


Fig. 23: WMS server settings for turistautak.hu maps

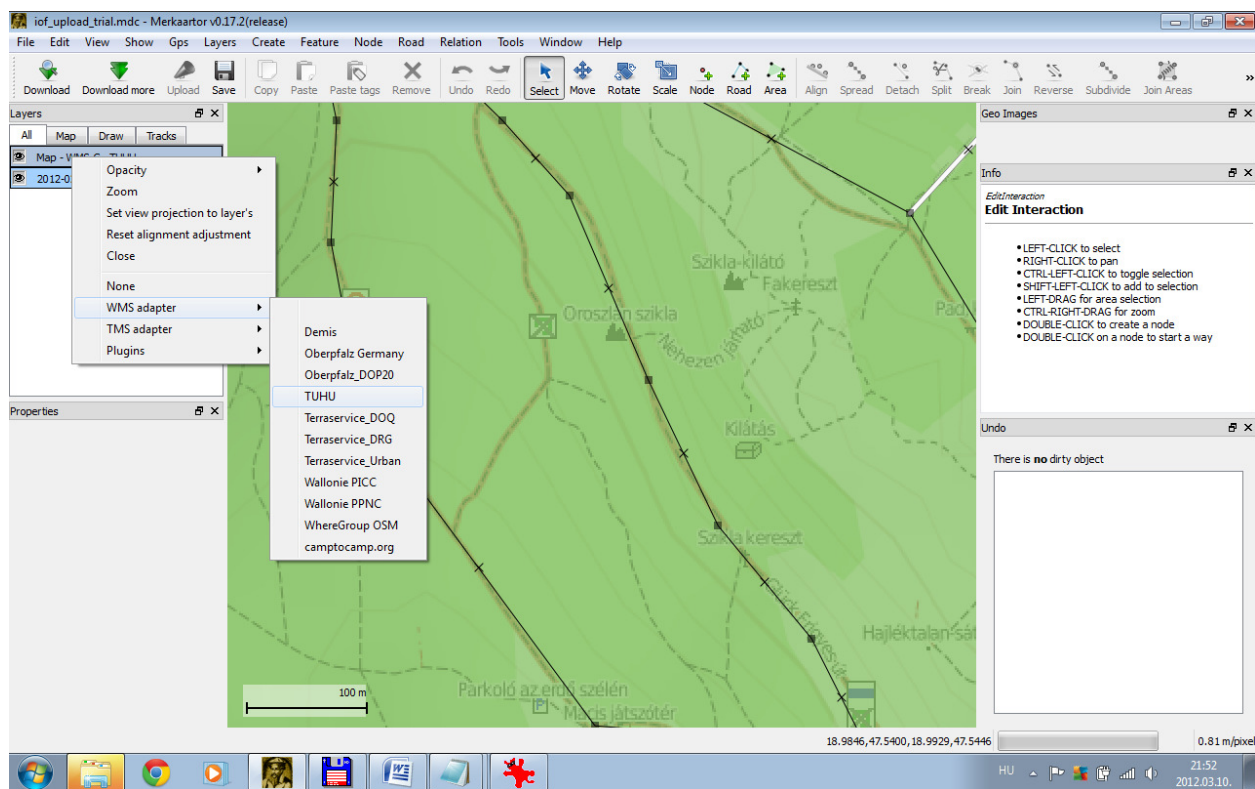


Fig. 24: WMS map source (TUHU) as background image

Walking papers: Setting own scanned map as background

OCAD has a feature for importing and calibrating a scanned map image then set it as background. Unfortunately **Merkaartor** has no such functionality; therefore the following complicated method has to be applied:

Generate a **Walking paper** for the chosen area at <http://walking-papers.org/> site. Save the URL of generated **Walking paper** as a bookmark because **Merkaartor** will need this URL for calibrating the picture. Manipulate the generated Walking paper pdf file in an advanced photo editor (**Gimp** or **Photoshop**) according to the following process.

Manipulating a Walking paper (e.g. for using an old orienteering map as background) is a complicated process. However it not necessary to be performed by each user. It is enough if the coordinator of a map area performs it once in a period then shares it with the map editing community. Setting a manipulated Walking paper as Merkaartor background is easy and can be done by each user.

As old orienteering maps (created without GPS survey) can have strong distortions, so their accuracy has to be checked (e.g. by comparing to a WMS map source, existing OSM tracks or own GPS tracks for the given map area)

Main steps of the procedure are the following:

- Open the generated Walking paper pdf in an advanced photo editor (**Gimp** or **Photoshop**)
- Open your desired background image (e.g. old orienteering map) in a separate window of the photo editor. Cut the desired area then add it onto the walking paper image as a new layer.
- Set the transparency of the new layer to highly transparent
- Calibrate the transparent layer containing your desired background image onto the walking paper by resizing and moving it. Generally several resize/move cycles are necessary for perfect matching of the background image onto the walking paper. Sometimes a small rotation is also necessary. In **Gimp** editor push the *Ctrl* button while resizing in order to keep the proportion of vertical and horizontal dimensions. In case of old maps it can happen that exact matching is not possible due to distortions. In this case consider splitting old map into smaller areas and calibrate them separately.
- After having exact (or at least acceptable) matching between the original walking paper and the desired background image, transparency of upper layer can be set back to 0.
- Crop the result image on the edges of original walking paper map. (**Walking paper** positioning will be wrong in **Merkaartor** editor if borders are not removed by this crop operation).

This process seems complicated (as it is), but having some practice it can be done within a few minutes. Gimp photo editor is free and can be downloaded <http://www.gimp.org/> site.

The above calibration/matching process is called georeferencing.

Setting Walking paper as Merkaartor editor background

Follow the method below in order to have the **Walking paper** as background of **Merkaartor** editor:

- Create a new image layer for the background: *Layers > Add new Image layer*; right click on the label of new layer ("*Map - None*"), then select the following in the pop-up menu *Plugins > Walking Papers*
- Load the Walking paper into the new image layer: right click on the label of new layer ("*Map - Walking Papers*"), then select the following in the pop-up menu *Load Image*, and give the access path of the Walking paper image file. Merkaartor will ask the URL of the **Walking paper**. This is the URL of the generated Walking paper when generating it at <http://walking-papers.org/> site. This URL is usually contained by the filename of the **Walking paper** image.

Remarks:

- There is functionality for automatic detection of **Walking paper** URL using **zbar** software for reading the **QR code** on the image. In this case it is not necessary to manually type in the URL of **Walking paper**, but this functionality is not reliable.

- When loading a **Walking paper** image it is highly recommended to set the map position and zoom level for matching the map area of editor window with the **Walking paper**.
- If positioning of **Walking paper** image is wrong then its border probably was not properly removed after scanning/editing. (**Walking paper** image has to be borderless for exact positioning. Removing the borders by cropping can be done by any picture editor software.)



Fig. 25: Original Walking paper (after removing its borders)

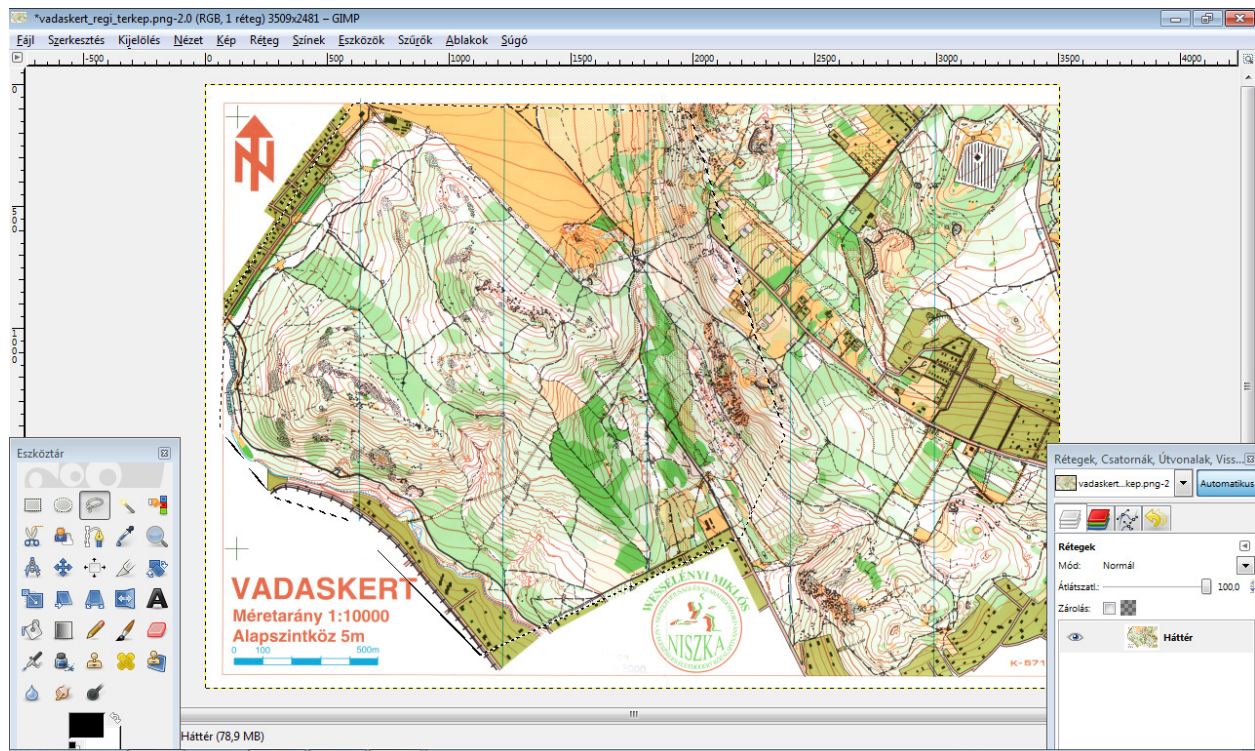


Fig. 26: Selecting the desired map area of old orienteering map for cutting in Gimp editor

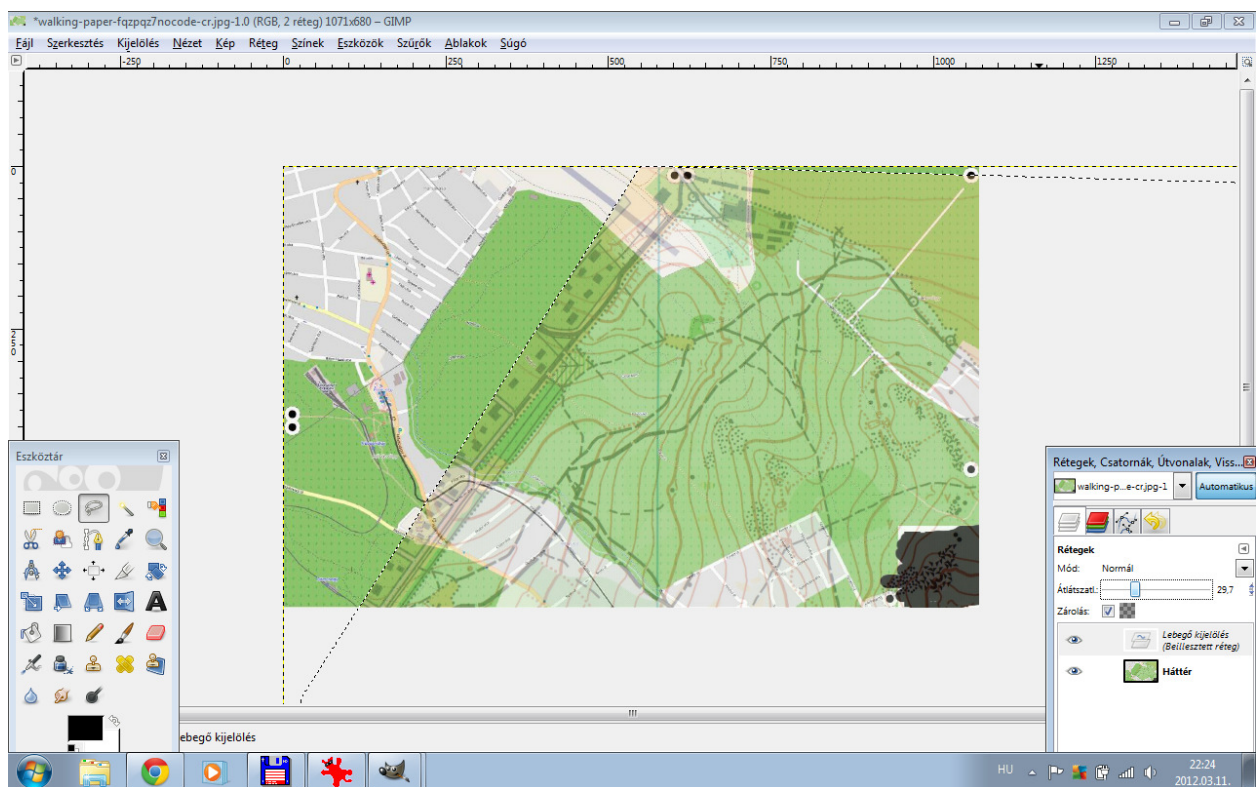


Fig. 27: Copying old orienteering map onto walking paper then setting its transparency to a high value in Gimp editor

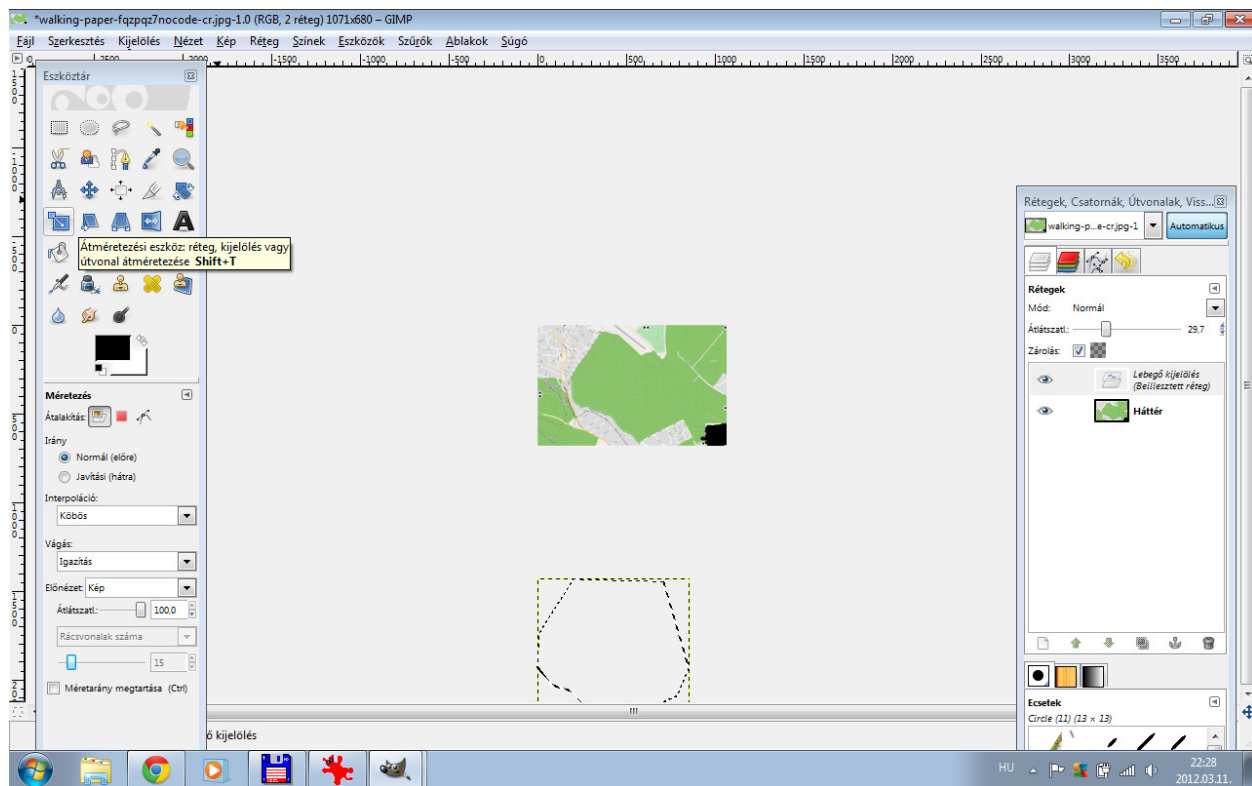


Fig. 28: Resizing old map in Gimp editor

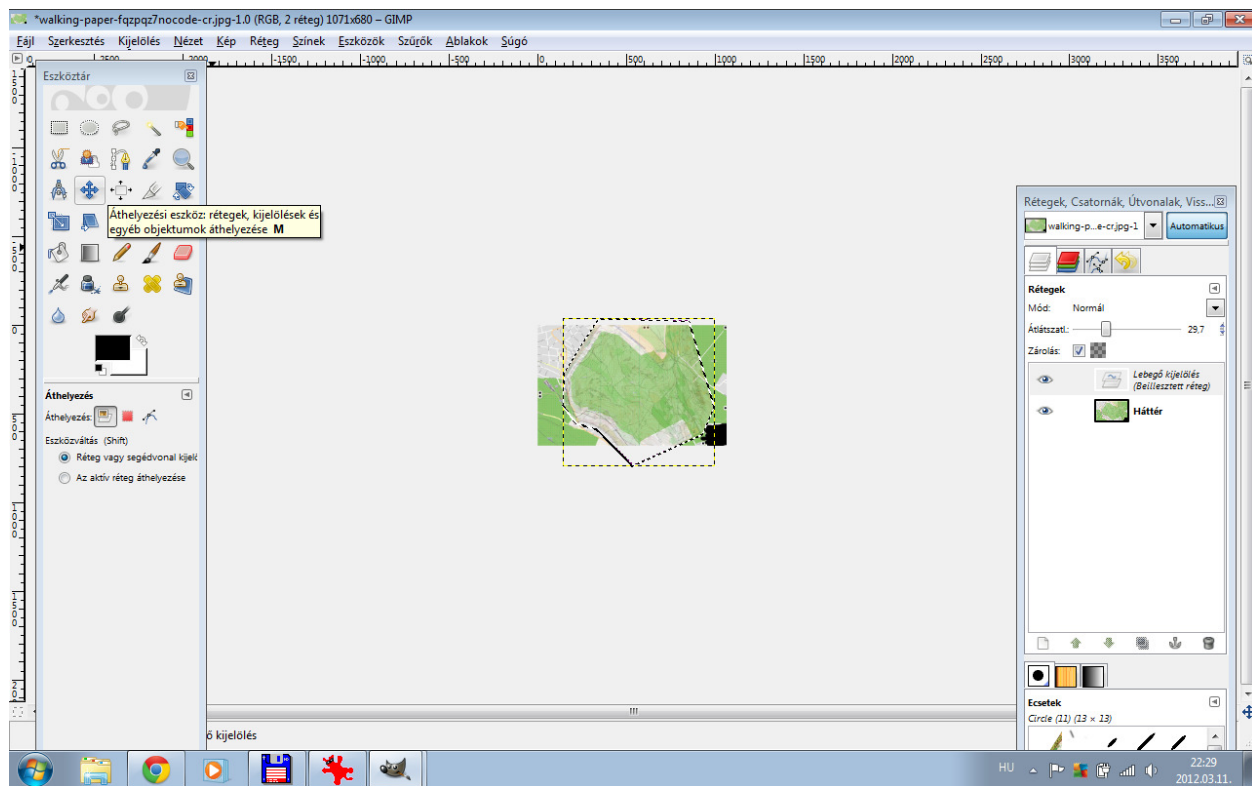


Fig. 29: Moving old map onto walking paper in Gimp editor

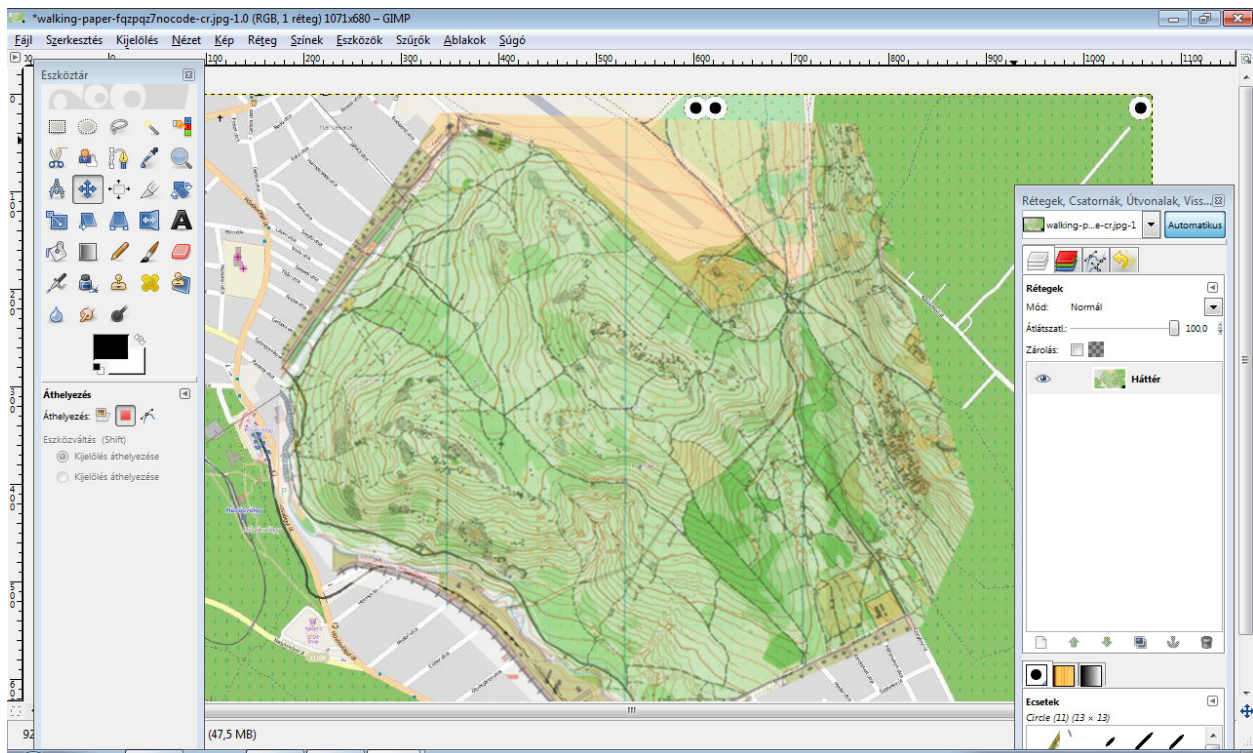


Fig. 30: Final calibration before reset the transparency of old map



Fig. 31: Manipulated (georeferenced) Walking paper

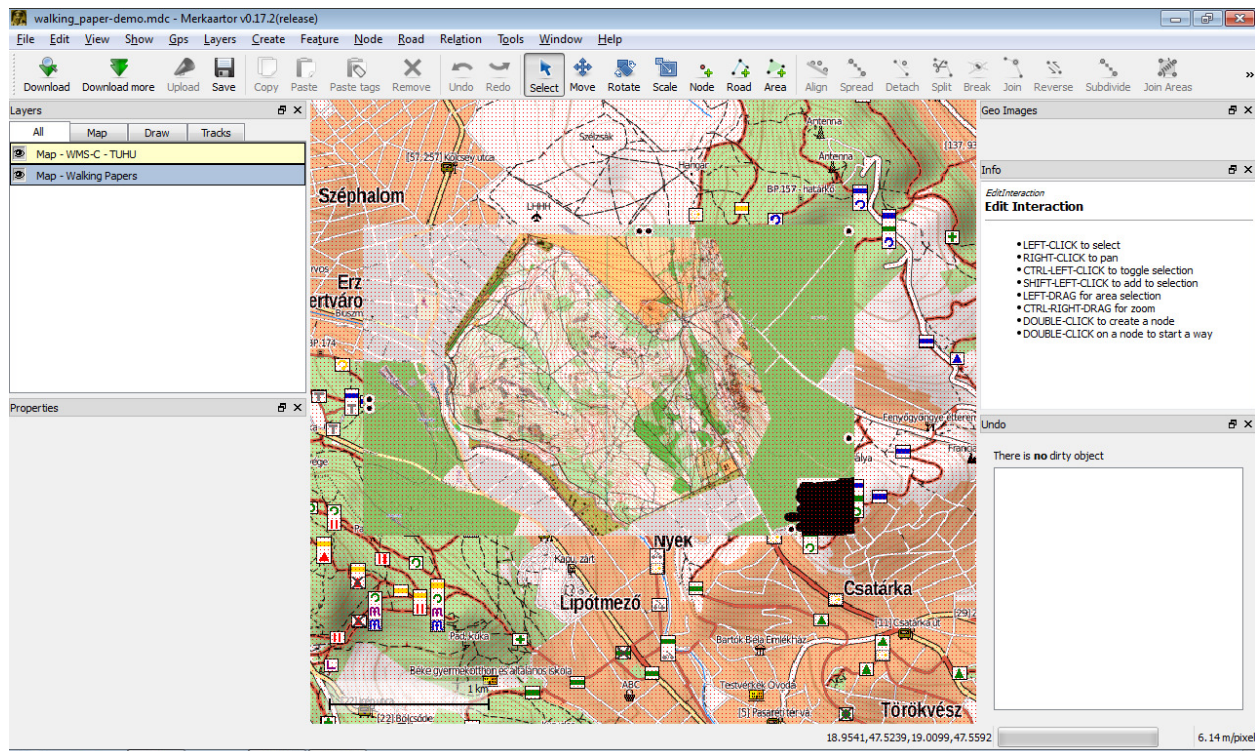


Fig. 32: Walking paper as background image in Merkaartor editor

Printing orienteering maps from OSM database

Quick prints by Merkaartor print menu

It is possible to export a map area into **pdf**, **png** or **svg** image by using *File > Print* menu of **Merkaartor** editor. This method is very simple however it has several limitations. The main limit is the style editor of **Merkaartor** than cannot handle exactly the IOSM symbols, so quasi symbols has to be used in some cases. Maps printed from **Merkaartor** contain also these quasi symbols instead of exact IOSM symbols. For having a map with exact IOSM symbols the **Osmarenderer** software has to be used (see next chapter).

Before printing from Merkaartor it is recommended to inactivate the disturbing highlight options:

- Inactivating indication of Dirty features: *Show > Highlight dirty features*, and then unselect the checkbox.
- Hiding the line nodes: *File > Print > Show nodes*, and then unselect the checkbox.

Remark: *Print* Menu of **Merkaartor** has minor bugs, so only the first exported picture file will be correct. In case of generating several picture files or having an error at exporting it is recommended to exit the *Print* menu, and then select it again.

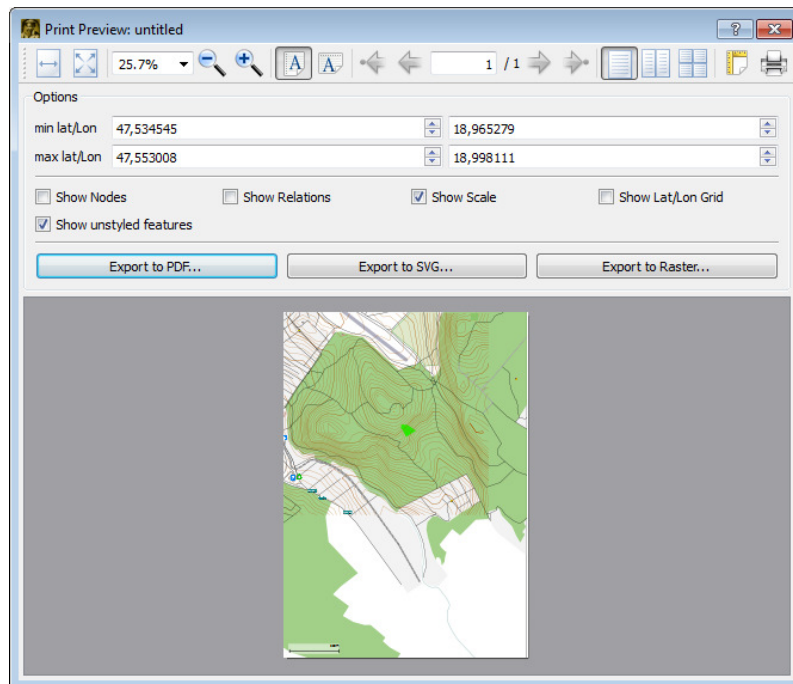


Fig. 33: Print menu of Merkaartor

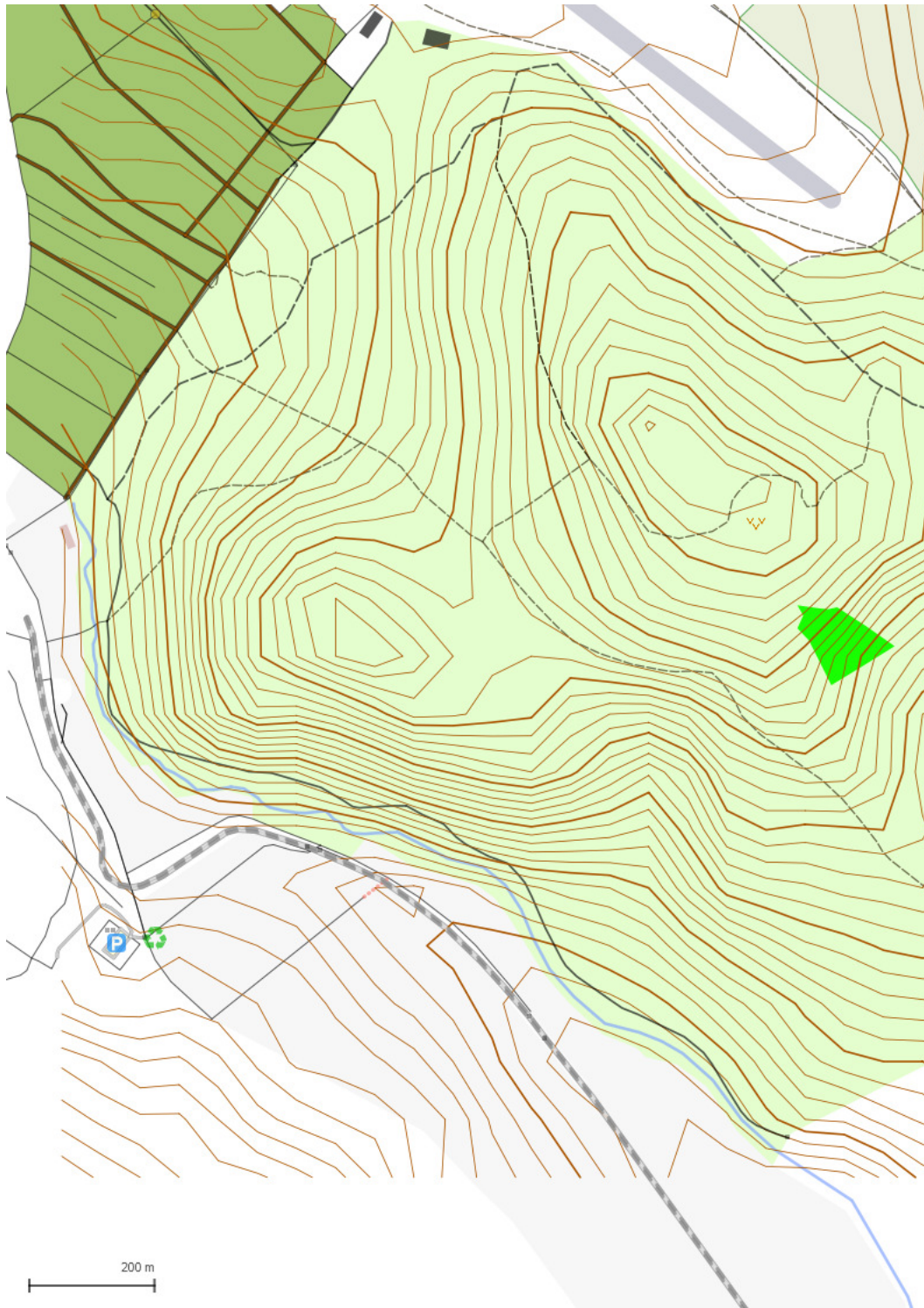


Fig. 34: Map image generated by Merkaartor Print menu

Map generation by Osmarenderer software

Printing orienteering maps with better quality can be performed by special o-map edition of **Osmarenderer** application, which was developed by David Svantesson. Using this method ISOM symbols appear correctly, however this printing process is more complicated.

It is not necessary to execute this process by each map editing user. It is enough if coordinator of a given map area performs it once or twice a year, and then publish the printable map file with other users.

Main steps of generating a printable orienteering map are the following:

- Unhide all layers containing o-map data in **Merkaartor** editor.
- Export map into *map.osm* file (*File > Export* menu, then select *osm(xml)* format)
- Save the **Merkaartor** project into an mdc file. It will enable reproducing this map version, and can be useful for recovery of OSM server database in case of vandalism.
- Copy the exported *map.osm* file into the directory of **Osmarenderer** application then launch the rendering process by *render.bat* command from command prompt.
- Perform the finishing works (corrections, hiding the unnecessary areas, adding north lines and text labels, etc.) on the resulting *map.svg* file in a vector graphical editor (e.g. **Inkscape** or **Adobe Illustrator**). **Inkscape** editor is free and can be downloaded from the following site: <http://inkscape.org/>.
- Do not forget to indicate the Open Street Map logo and the corresponding Creative Commons license (CC-BY-SA, see <http://www.openstreetmap.org/copyright> for details) on the map. There is an intellectual property right violation if these elements are not indicated on the map!

Useful tips for finishing works with **Inkscape** editor:

- Hiding the unnecessary parts of map: draw outline of desired map area, select all objects by *Ctrl+A*, then select *Object > Clip > Set* menu, finally save the clipped map into a new file (e.g. *map-clipped.svg*).
- Open the map template (e.g. *template_map_A4_landscape.svg*)
- Import the clipped map into the template (*File > Import*), move the map into the desired position then send it to background (*End* button of keyboard)
- Add your text labels onto map
- Save the finished map into a *svg* file.
- Proposed settings for printing:

- Inkscape Rendering method: raster 600dpi,
- Printer driver settings: picture quality

If there are minor problems with the order of layers, then they can be fixed in vector graphical editor. In Inkscape editor order of objects can be changed by selecting them then pushing the *PgDown*/*PgUp* buttons.

Important remark: standard version of **Osmarenderer** does not handle any IOF tags. Orienteering maps can be generated only by special orienteering edition of **Osmarenderer** developed by David Svantesson.

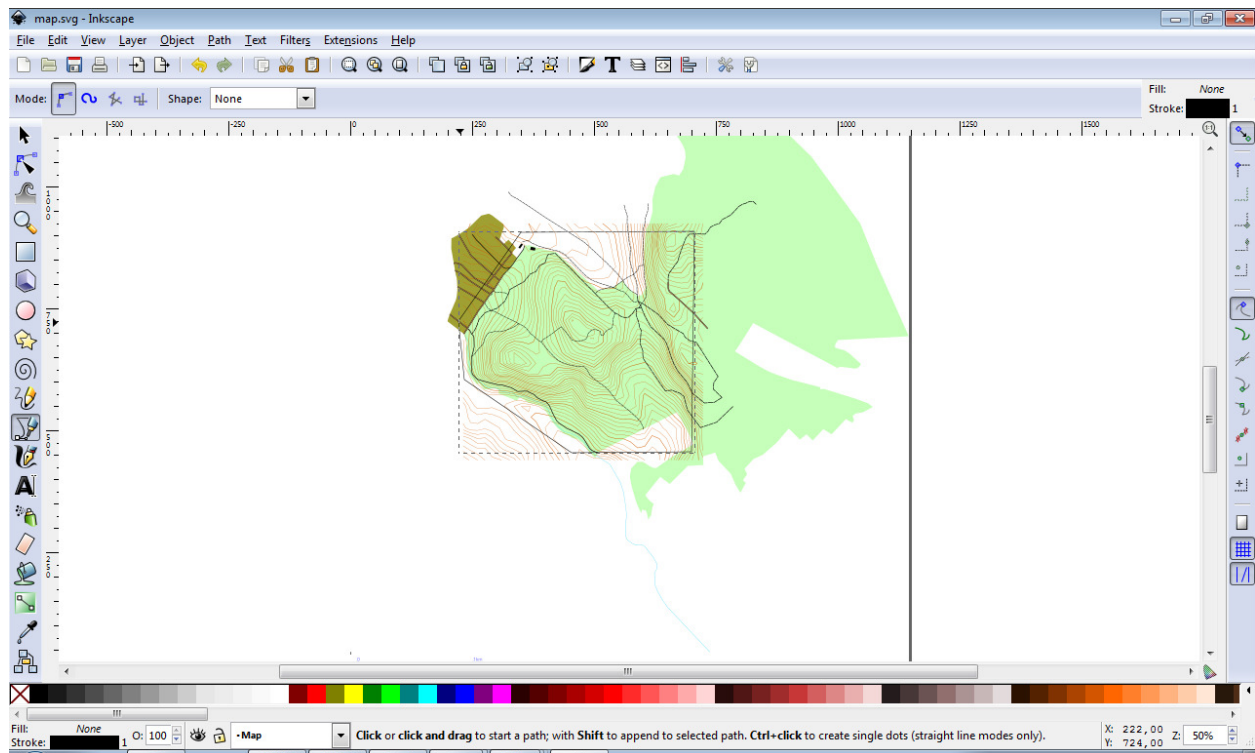


Fig. 35: Drawing outline of desired map area in Inkscape editor

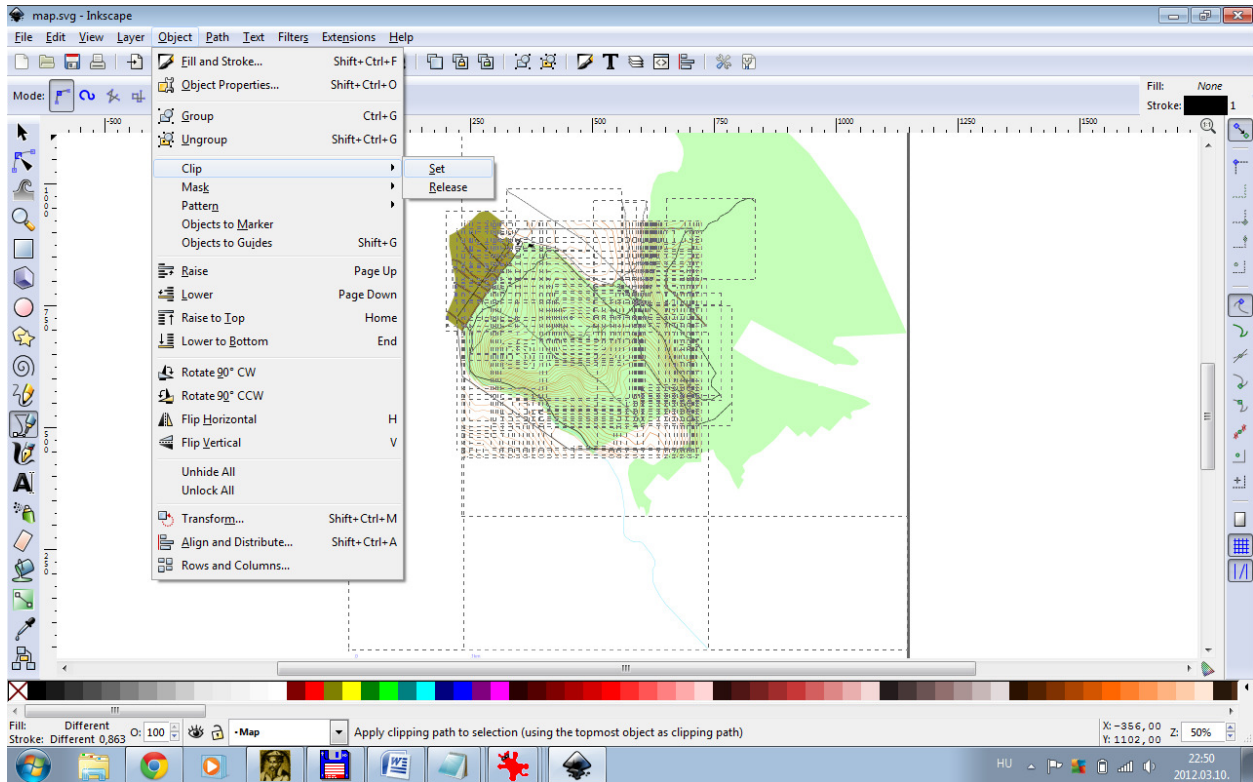


Fig. 36: Clipping the desired map area in Inkscape editor (Ctrl-A; Object > Clip > Set)

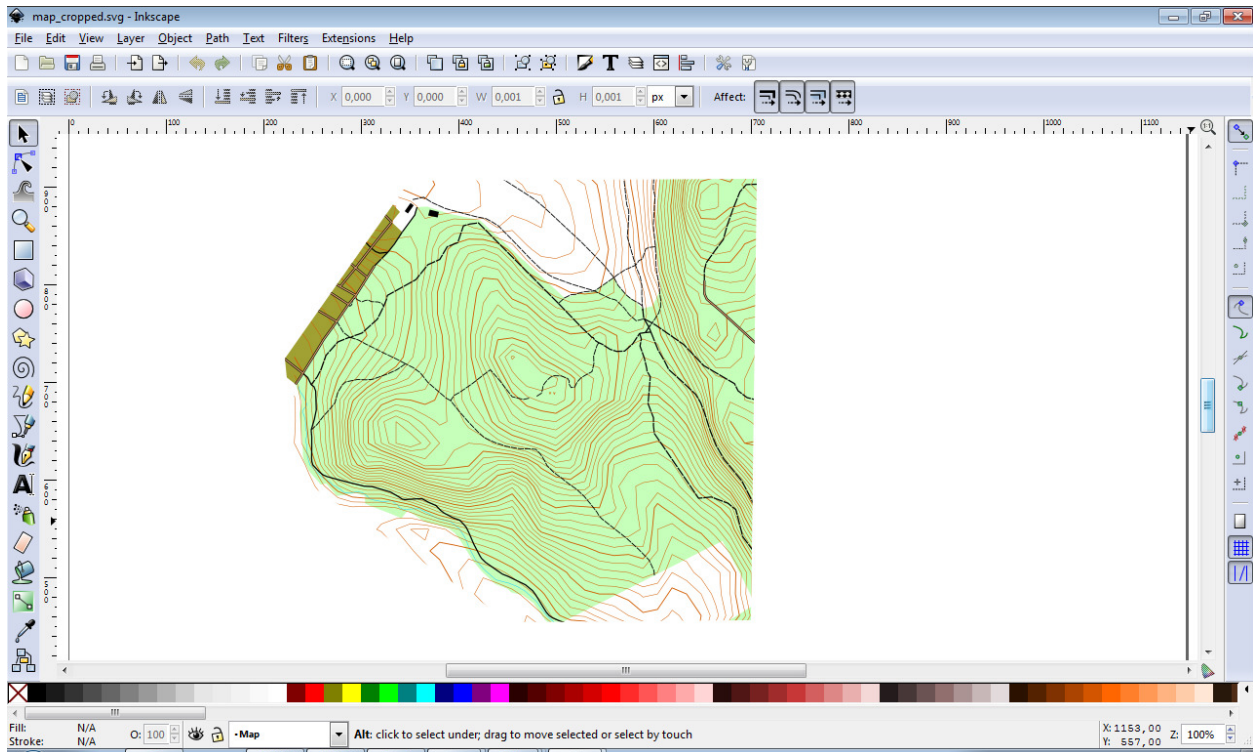


Fig. 37: Clipped map area in Inkscape editor

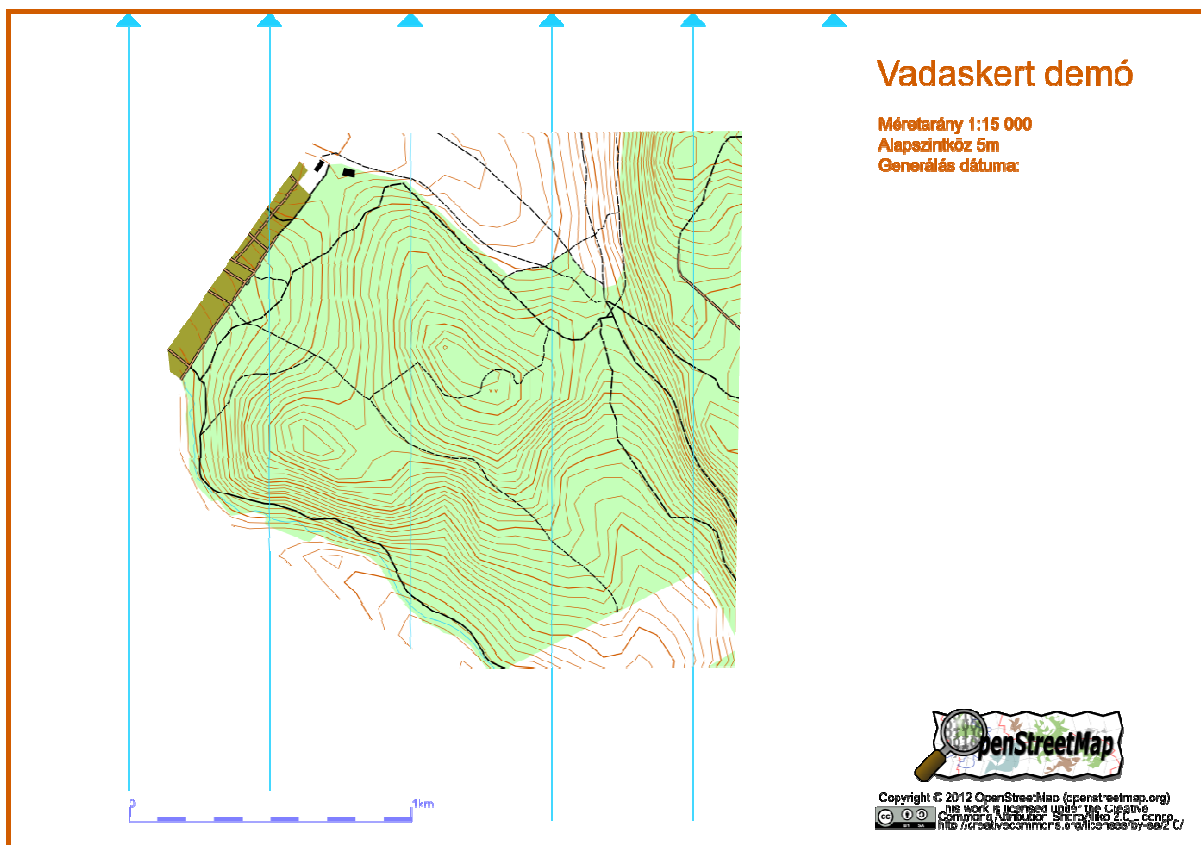


Fig. 38: Map after importing it into map template

Annex A: Tagging rules of ISOM symbols














(Based on <http://wiki.openstreetmap.org/wiki/IOFmapping>, but having minor modifications and updates)

Default values are marked with underlined characters. It is not necessary to add tags for default values.

Land forms

It is forbidden to upload contours onto OSM server (other landform objects can be uploaded)!

Contours have to be exported into a separate OSM file, and this file has to be shared within the map editing community.

Value for iof= key notation	Type	IOF code	Comment	Extra key=value pairs	Rendering example (not to scale)	corresponding osm tags
contour		101, 102, 103	Height contours	type= <u>normal</u> /index/form. altitude=[meter] to specify height over sea		
slope_line		104	Draw slope line for node on a contour.			
earth_bank	 	106	Earth banks. For a small earth bank you could use a single node	size= <u>normal</u> /high		<code>barrier=earth_bank</code> or <code>man-made=embankment</code> . For earth banks along both sides of a way also <code>embankment=yes</code> or <code>cutting=yes</code> . Optionally: <code>height=*</code> so that the renderer can decide whether a slope is high or not. Should it be mapped as an area to define a varying length of the slope lines?
earth_wall		107, 108	Earth walls	size= <u>normal</u> /small		<code>barrier=earth_wall</code> optionally <code>ruins=yes</code>
erosion_gully		109, 110	Erosion gully	size= <u>normal</u> /small. area=yes/ <u>no</u> (for larger erosion gully)		way: <code>barrier=ditch</code> optionally <code>indistinct=yes</code>
small_knoll		112, 113	Knolls too small to be shown by contours.	elongated:yes/ <u>no</u> . direction:[0-360] for direction of long side of elongated knoll.		node: <code>barrier=earth_wall</code> or <code>historic=tumulus</code> or <code>historic=archaeological_site</code> with <code>site_type=tumulus</code> optionally <code>direction=*</code> for elongated knolls

small_depression		115	Small shallow natural depressions and hollows	depth=[meter]		barrier=ditch with indistinct=yes
pit		116	Pits and holes with distinct steep sides.	depth=[meter]		barrier=ditch
broken_ground		117	Broken ground			area: barrier=ditch or barrier=earth_wall with area=yes optionally: runnability=*
special_landform		118	Special land form feature	Description:User Defined		(something you map appropriately and configure the renderer to show it as IOF118_special-landform)

Rocks and boulders

Value for iof= key notation	Type	IOF codes	Comment	Extra key=value pairs	Rendering example (not to scale)	corresponding osm tags
cliff		201, 203	Passable or impassable cliffs.	passable: yes /no. tags: yes /no. direction:[0-360] for nodes		natural=cliff barrier=retaining_wall waterway=dam optionally: foot=passable
rock_pillars		202	Rock pillars or gigantic boulders			natural=cliff area=yes
rocky_pit		204	Rocky pit			barrier=ditch node together with natural=cliff or barrier=retaining_wall
cave		205	Cave	direction=[0-360]	see rocky_pit	natural=cave_entrance
boulder		206, 207	Boulders of different sizes	size= small /medium/large, height=[meter]		optionally indistinct
boulder_field		208	Part of a field of boulders			

boulder_cluster		209	A small distinct group of boulders so closely clustered together that they cannot be marked individually.	size= <u>normal</u> /large?		
stony_ground		210	Stony ground			natural=scree optionally runability=* , alternative when area is not a scree, like a stony forest?
open_land, surface:sand		211	Open sandy ground			natural=beach , alternative when area is not a beach area=yes and surface=sand
bare_rock		212	Bare rock			landuse=quarry alternative when area is not a quarry? natural=bare_rock tag?

Water and marsh


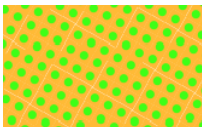

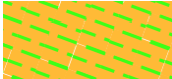

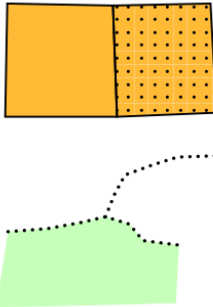


Value for iof= key notation	Type	IOF code	Comment	Extra key=value pairs	Rendering example (not to scale)	corresponding osm tags
water		301, 302, 304, 305?	Water areas (lakes, ponds, rivers)	bank_line: <u>yes</u> /no. passable:yes/ <u>no</u> (issom)		natural=water (natural=land for islands within), waterway=dock , for large rivers use waterway=riverbank optionally foot=passable
river		304	Smallest size for river, alternative or combined with water.	bank_line: <u>yes</u> /no. passable:yes/ <u>no</u>		waterway=river waterway=canal
bank_line		301, 304	Bank lines to water areas (also see water)		See water	foot=passable removes bank line for waters
watercourse		305, 306, 307	Crossable watercourses. Large watercourses could be combined with water.	size=large/ <u>small</u> /minor , width=[meter]		waterway=river with foot=passable / waterway=stream or waterway=drain (medium) / the latter both optionally with indistinct=yes .

waterhole		303	Water-filled pit			node: barrier=ditch with natural=water
narrow_marsh		308	A narrow marsh			way: natural=wetland or natural=mud
marsh		309, 310, 311	Marsh that could be shown as an area	type= impassable / normal / indistinct		natural=wetland / with foot=passable / with "indistinct" / same with nodes, natural=mud ?
well		312	Well			waterway=water_point possibly man_made=water_well older proposal
spring		313	Source of a stream. When placed on the start of a watercourse , erosion_gully or narrow_marsh the direction is automatically oriented downstream.	direction:[0-360]		barrier=ditch node with indistinct and natural=water / natural=spring node optionally with a starting waterway
special_water		314	Special water feature	Description:User Defined		amenity=fountain , ({Tag amenity drinking_water} man_made=water_tower man_made=watermill man_made=reservoir_covered , ... (something you map appropriately and configure renderer to show it as IOF314_special-water)

Vegetation


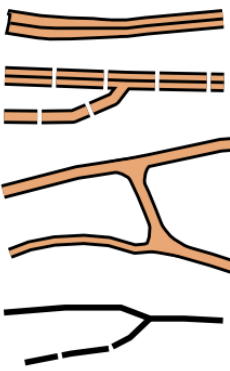



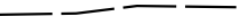





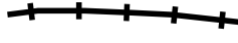
Value for iof= key notation	Type	IOF code	Comment	Extra key=value pairs	Rendering example (not to scale)	corresponding osm tags





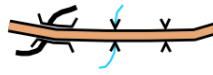





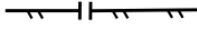



open_land		401, 403, 415	Different types of open land (No default value for 'surface' key because of rendering reasons)	surface: normal/rough/cultivated		open: natural=heath landuse=village_green landuse=recreation_ground leisure=park cultivated landuse=farm_rough landuse=meadow natural=scrub natural=fell .
open_land_in_forest		401, 403, 415	Same as open_land, but rendered over the forest area. It means that cutting hole into a forest can be avoided if this tag is used.	surface: normal/rough/cultivated		
scattered		402, 404	Semi-open land with scattered trees. To be used over a forest area (It adds the yellow pattern over the white/green forest.)	surface: normal/rough		(for scatered trees also tag forest/wood, see next)
forest		405, 406, 408, 410, 411	Forests with different running speed. Normal (white) forest is normally not needed to tag. Very_difficult and impassable are synonyms (No default value for 'running' key because of rendering reasons)	running:easy/slow/ difficult/ very_difficult/ impassable. one_direction:yes/ <u>no</u> . direction:[0-360]		natural=wood or landuse=forest shade according to runnability=* , impassable also barrier=hedge (node, way or area with area=yes) all optional direction=* and wood=* stating the (wood) vegetation type in an area (coniferous/deciduous/mixed).
undergrowth		407, 409	An area of dense undergrowth but otherwise good visibility	running:slow/difficult		barrier=hedge with area=yes foot=passable and runnability=*

orchard		412	Land planted with fruit trees or bushes.	direction:[0-360]		
vineyard		413	Vineyard	direction=[0-360]		landuse=vineyard
boundary		414, 416	Different type of boundaries between areas	type=distinct_cultivation/ distinct_vegetation		Marking an area or way indistinct=yes states it has a less sharp/visible vegetation boundary (may remove an outline shown). (A "way" tagged natural=wood landuse=forest or landuse=farm and area=no may state a corresponding single (open loop) vegetation boundary?)
special_vegetation		418, 419, 420	Special vegetation feature	Description: User Defined. display= cross /circle/dot		example could be natural=tree (something you map appropriately and configure the renderer to show it as IOFxxx_special-vegetation_x/o)

Man-made features

Value for iof= key notation	Element	IOF code s	Comment	Extra key=value pairs	Rendering example (not to scale)	corresponding osm tags
-----------------------------	---------	------------	---------	-----------------------	----------------------------------	------------------------

road		501, 502, 503, 504, 505	Roads suitable for vehicles	type=motorway/major/ minor/narrow/track. area=yes/ <u>no</u> . construction:yes/ <u>no</u> .		501 motorway: highway=motorway . highway=trunk 502 major road: highway=primary . highway=secondary 503 minor road: highway=primary link highway=residential highway=living_street highway=bus_guideway 504 road: highway=unclassified highway=service . highway=track with tracktype=grade1 505 vehicle track: highway=track with tracktype=grade2 highway=bridleway highway=footway highway=cycleway . cycleway=track (if distinct way, not part of a larger road) Optionally: width=* (or est_width=*), and highway=construction for roads in construction. (Maybe some rules using surface= or Proposed features/surface unification could be usefull to improve appropriate rendering.)
path		506, 507, 508	Paths	type=large/small/indistinct.		506 footpath: highway=track with tracktype=grade3 and lower. highway=path with trail_visibility=excellent 506 small path: highway=path with trail_visibility=good and trail_visibility=intermediate 507 less distinct path: highway=path with trail_visibility=bad , and trail_visibility=horrible (consider adding sac_scale=* classification for hiking paths: Approved features/Hiking)
narrow_ride		509	A distinct ride			
??		510, 511	Whether a junction easily could be seen in competition speed -> Not yet implemented	?		
bridge		512	A footbridge with no path leading to it. The direction is automatically oriented if on a watercourse, erosion_gully or narrow_marsh	direction:[0-360]		A waterway node with bridge=* level -1 below other features and (foot=designated or foot=forestry or foot=passable (perpendicular crossing) / A (trail) way with bridge=* and level= (above other features) (angled crossings like regular)
bridge:yes		513, 514	Whether a path over a watercourse have a bridge over it or not.			use level=* and bridge=* or highway=ford ap propriately
Railway		515				railway=* or railway=tram

power_line		516, 517	<p>Powerline.</p> <p>Pylons are automatically rendered to each nodes of line (except beginning and end of line)</p> <p>For major power line a double power line may be drawn.</p>			<p>power=line major lines: voltage=* >= 110000V?, cables=* >=5? also: aerialway=cable_car aerialway=gondola aerialway=chair_lift aerialway=drag_lift</p>
power_pylon		517	<p>Pylon on a power line -></p> <p>Not needed to use as nodes of power line are automatically rendered as pylons.</p>		See power_line	power=tower
tunnel		518	<p>A way under roads, railways, etc. which may be used by the runner.</p> <p>This symbol is used whether or not the tunnel has a track leading to it. (maybe smallest as node on road?)</p>	<p>part:extent/opening/edge. width=[meter].?</p>		<p>tunnel=yes bridge=* both used together with layer=*</p>
stone_wall		519, 520, 521	<p>Walls made of stone</p>	size= normal /ruined/high.		<p>barrier=wall, also historic=city_wall optionally: ruins=yes, foot=passable</p>
fence		522, 523, 524	Fences	size= normal /ruined/high		<p>barrier=fence optionally: foot=passable, ruins=yes</p>
crossing_point	 ?	525	<p>All ways through or over high fences or walls must be indicated. Direction is aligned automatically if placed onto a fence, stone_wall or pipeline</p>			<p>barrier=gate barrier=entrance barrier=stile barrier=sally_port</p>
building	 	526	Buildings	For nodes: direction:[0-360]		<p>building=* power=station power=sub_station aerialway=station amenity=shelter tourism=alpine_hut tourism=chalet</p>

settlement		527	Houses and gardens and other built up areas.	type= <u>normal</u> /striped boundary= <u>yes</u> / <u>no</u>		leisure=playground leisure=garden landuse=farmyard landuse=allotments landuse=residential Key:ill=sports_centre leisure=track leisure=water_park leisure=miniature_golf and maybe a couple more ...
permanent_out_of_bounds		528	Permanently forbidden	boundary: <u>yes</u> / <u>no</u>		access=no , access=private , foot=no foot=private optionally indistinct
paved_area		529	An area of hard standing used for parking or other purposes.			amenity=parking highway=pedestrian highway=service junction=roundabout amenity=ferry_terminal amenity=bus_station ...
ruin		530	Ruin			building=* with ruins=yes
firing_range		531	Firing range (usually way with two nodes). target at end of line.			
grave		532	A distinct grave.			amenity=grave_yard landuse=cemetery
pipeline		533, 534	Pipelines	passable: <u>yes</u> / <u>no</u>		man_made=pipeline optionally foot=passable
tower		535, 536	Tower	size= <u>high</u> / <u>small</u>		amenity=hunting_stand man_made=tower (also min. required: tower:type=*) man_made=water_tower man_made=lighthouse
cairn		537	Cairn, memorial stone or boundary stone			man_made=survey_point historic=memorial
fodder_rack		538	A fodder rack which is free standing or built on to a tree.			
special_manmade		539, 540	Special man-made feature	Description:User Defined. display= <u>cross</u> /circle.		could be a kiln/platform? (Meilerplateu) barrier=bollard barrier=cycle_barrier barrier=cattle_grid barrier=toll_booth amenity=bench amenity=emergency_phone amenity=telephone amenity=waste_basket amenity=amenity=grit_bin amenity=sionpost (or tourism=information with information=guidepost)(something you map appropriately and configure the renderer to show it as IOFxxx_spciaal-man-made_x/o)

Annex B: Appearance of ISOM symbols in Merkaartor editor and in Osmarenderer output

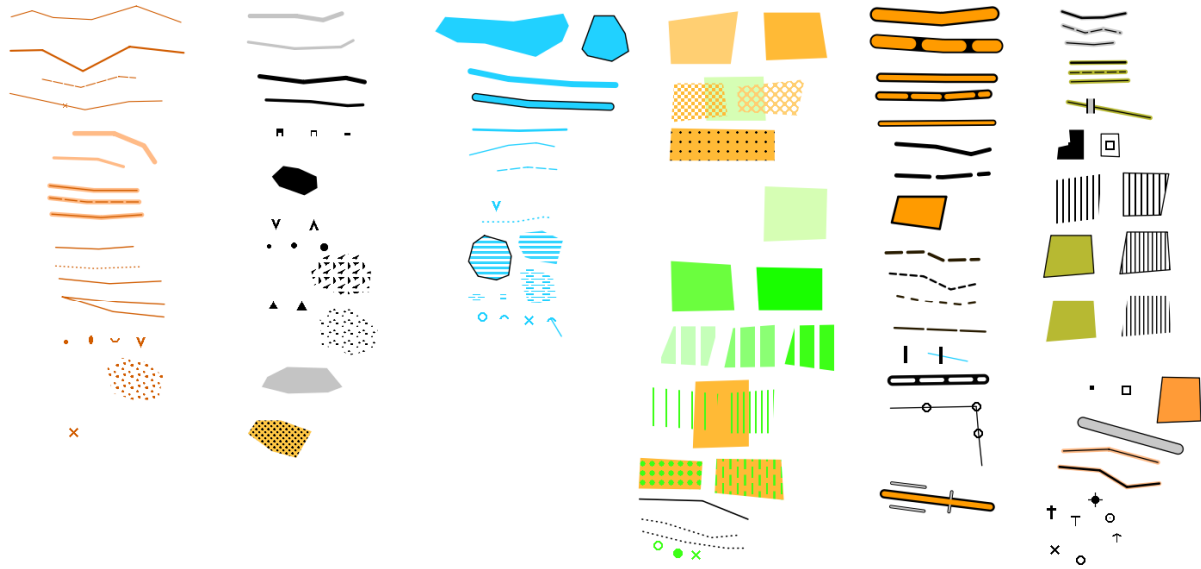


Fig. 39: Appearance of ISOM symbols in Merkaartor editor (quasi symbols)

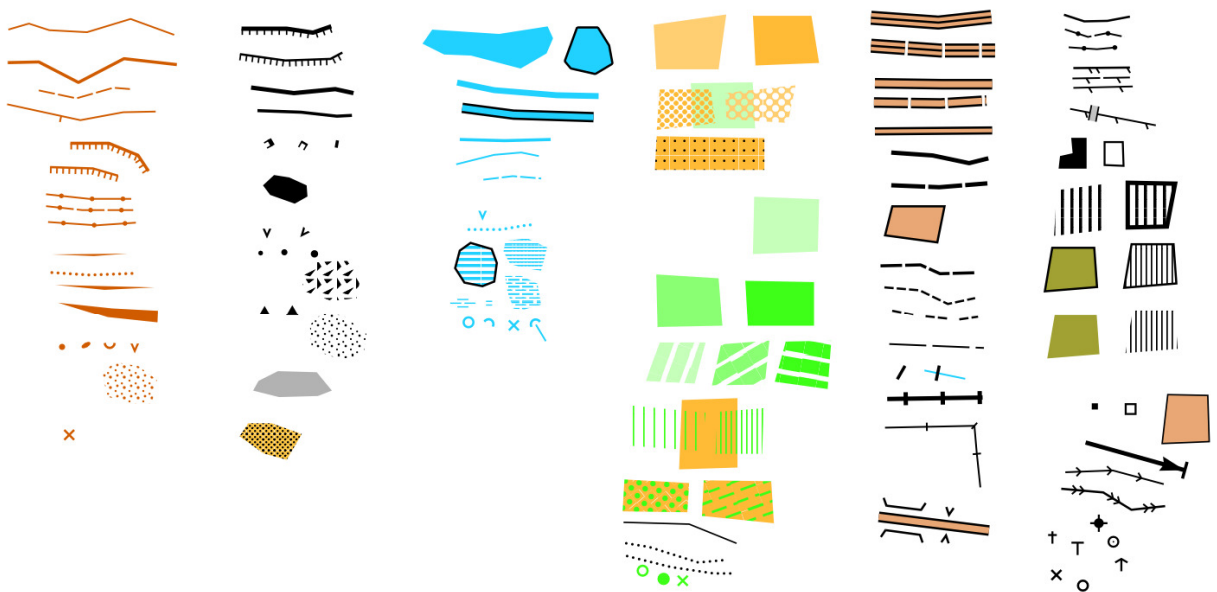


Fig. 40: Appearance of ISOM symbols in Osmarenderer output files (real symbols)

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